SECTION 3.0: AFFECTED (BASELINE) ENVIRONMENT

This section describes the relevant resources and baseline conditions present in the project area that would be affected by or might affect the proposed action (reissuance of a NPDES general permit). The section describes the baseline conditions against which decision makers and the public can determine the potential environmental consequences of the proposed action and alternative actions, compare those effects, and assess their significance.

3.1 GEOLOGY

3.1.1 Regional Geology

Cook Inlet is a tidal embayment of the North Pacific Ocean projecting north-northeast over 180 miles (290 kilometers) into the south-central Alaska coast. To the north, lower Cook Inlet narrows to a width of about 86 miles (140 kilometers) near Kamishak and Kachemak Bays, and to about 31 miles (50 kilometers) near Kalgin Island. Cook Inlet lies between the Talkeetna Mountains to the northeast, the Chugach and Kenai Mountains to the southeast, and the Alaska-Aleutian Range to the northwest. To the southwest, lower Cook Inlet connects to the Shelikof Straight, which extends another 168 miles (270 kilometers) to the North Pacific Ocean. To the southeast, Cook Inlet opens to the Gulf of Alaska through the Stevenson and Kennedy Entrances flanking the Barren Islands (MMS 2003).

Lower Cook Inlet and Shelikof Strait are structural geologic basins formed by plate-subduction tectonics (MMS 2003). These structural lows and the mountains surrounding them have been sculpted into their present morphology primarily by the direct or indirect action of glaciers (MMS 2003). The processes responsible in the past for shaping the geomorphology of this region are active today: earthquakes, faulting, volcanism, ice fields, alpine glaciation, tsunamis, and high-velocity tidal currents. Several historically active volcanoes line the northwestern side of Cook Inlet and Shelikof Strait; north to south they include Mount Spurr (which erupted in 1953 and 1992); Mount Redoubt (which last erupted in 1989–1990); Mount Iliamna (which has had numerous steam and ash eruptions); Mount Augustine (with historic eruptions in 1812, 1883, 1902, 1935, 1963–1964, 1976, and 1986); and Mount Katmai/Novarupta (which last erupted in 1912). The mountains and lowlands surrounding Cook Inlet and Shelikof Strait exhibit the full range of glacial features, including ice fields; active alpine glaciers; arêtes; horns; hanging valleys; U-shaped valleys; drumlins; erratic boulders; outwash plains; deltas; eskers; glacial lakes; and ground, terminal, medial, and lateral moraines (MMS 2003).

The offshore geology of Cook Inlet and Shelikof Strait also displays evidence of past sea-level fluctuations, volcanic activity, faulting, and glaciations. High-resolution seismic data from lower Cook Inlet reveal seafloor and subsurface features originating from glaciers and modified by high tidal currents and Holocene marine deposition. The seafloor features include sand waves, megaripples, sand ribbons, lag gravel, ice-rafted boulders with associated comet marks, and volcanic debris flows. The subsurface features include terminal, lateral, and ground moraines; lacustrine, glaciofluvial, and glaciomarine deposits; drainage channels; tunnel valleys; eskers; outwash fans; and sand waves. High-resolution geophysical data from Shelikof Strait reveal extensive deposits of Pleistocene glaciomarine and Holocene marine deposits. The Shelikof Strait seafloor generally is featureless with the exception of a few tectonic structures, such as fault scarps and possible remnant volcanic features (MMS 2003).

The basin and mountain ranges were formed by plate tectonics, and earthquakes and active volcanoes are common to the area (MMS 2003).

3.1.2 Sediment and Soils

The onshore soils consist of a surface layer of organic rich soil extending to a depth of a few feet. The surface layer is either wet organic soil or windblown silt, and glacial outwash silts and sands. The underlying layers are made up of densely packed soils formed under the Beluga Formation consisting of silts, with beds of sand, coal, and clay (SAIC 2002). The region is classified as a nonpermafrost area and has a maximum seasonal frost depth of 10 to 12 feet. Wetland soils consisting of thick organic surface soils provide poor foundations for infrastructures such as roads.

The sedimentary layers of Cook Inlet Basin are composed of conglomerates, sandstones, siltstones, limestone, chert, volcanics, and clastics. Upper Cook Inlet seafloor sediments consist of silts, sands, gravels, cobbles, and boulders with occasional bedrock outcrops, and underlying highly consolidated glacial till. High tidal currents have resulted in a layer of gravel, cobble, and boulders covering the seafloor, as well as formations of sand and gravel waves. Other features of high current regimes, including sand and gravel waves, are also common in the upper inlet. The surrounding beaches are composed of glacial silts and muds (SAIC 2002).

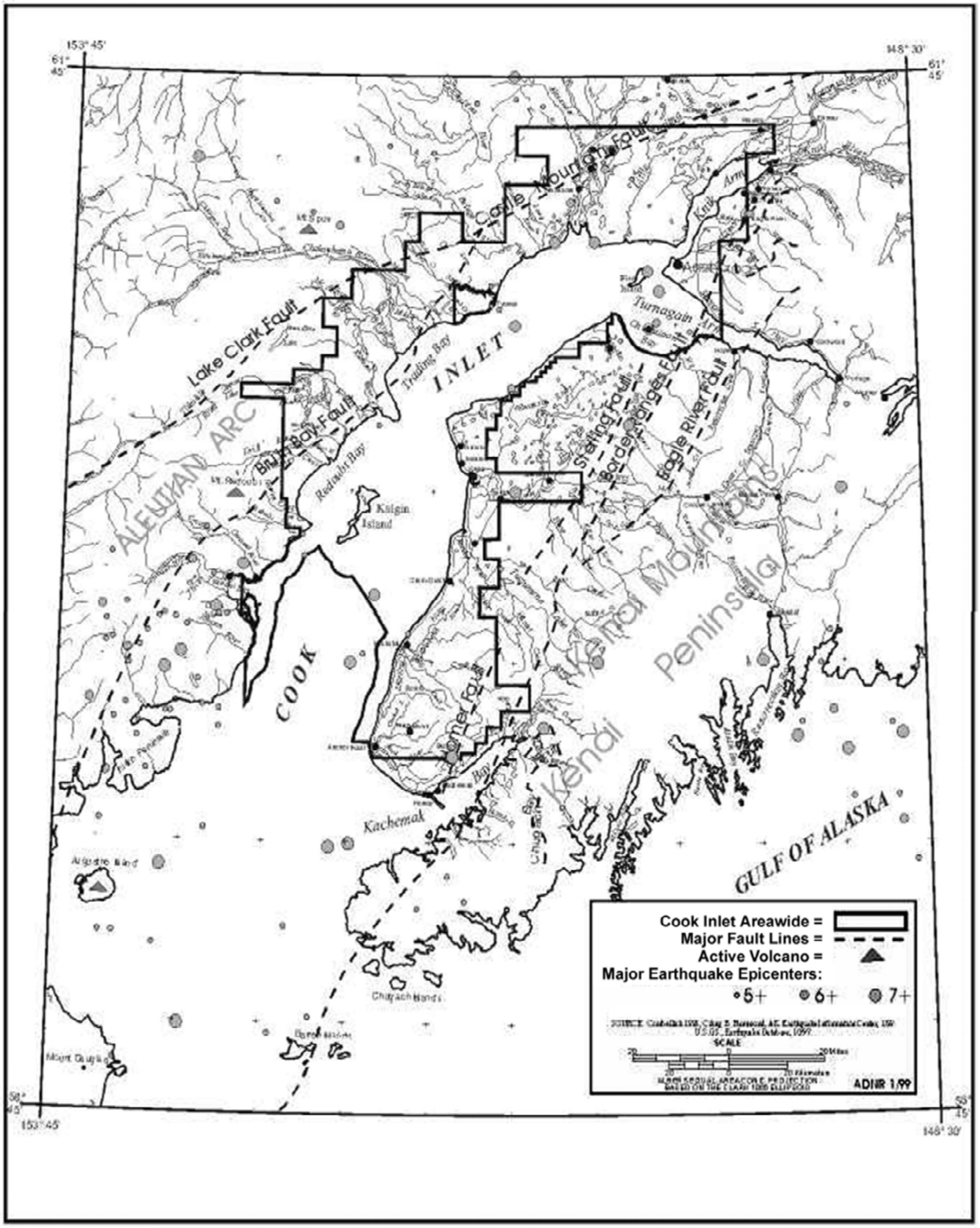
3.1.3 Geologic Hazards

Potential geologic hazards in Cook Inlet include earthquakes, volcanoes, seafloor sediment mobility and instability, and shallow gas-charged sediments.

3.1.3.1 Earthquakes

Cook Inlet is situated within one of the most active seismic zones along the Pacific Ocean (MMS 1995). The area is along the Aleutian Trench, the site of subduction of the Pacific and North American Plates. Over 100 earthquakes of magnitude 6 (Richter scale) or greater have occurred in the Cook Inlet area since 1902 (SAIC 2002). The last great earthquake in the Cook Inlet vicinity occurred in March 1964 and is estimated to have been of magnitude 9.2. Estimates of the recurrence interval of great earthquakes (greater than 7.8 on the Richter scale) range from 33 to 800 years. Major faults in the Cook Inlet area include the Bruin Bay and Castle Mountain faults to the northwest and the Border Ranges fault to the southeast (Figure 3-1) (SAIC 2002).

Figure 3-1. Major Geological Faults in Cook Inlet.



(Source ADNR 1999).

3.1.3.2 Volcanoes

The western boundary of Cook Inlet is one of the world's most active volcanic regions, bordered by five active volcanoes (Table 3-1). Since 1980, three volcanic eruptions have occurred in the Cook Inlet Basin, resulting in widespread ash distribution and consequent disruptions in air traffic and closure of oil platforms and other facilities. Hazards associated with volcanic activity include severe blasts, clouds of ash and gases, lightning, mudflows, pyroclastic flows, debris flows, flash floods, corrosive rain, earthquakes, and tsunamis (MMS 1995).

Table 3-1. Cook Inlet Area Volcanoes

Volcano	Historical Eruptions	Present Condition
Mt. Augustine	1812, 1883, 1908, 1935, 1963–64, 1976, 1986, 2006	Active and potentially eruptive
Mt. Iliamna	---	Active but steam only
Mt. Katmai	1912	Dormant
Mt. Redoubt	1902, 1936, 1967-68, 1989–90	Active and potentially eruptive
Mt. Spurr	1953, 1992	Active and potentially eruptive

Source: SAIC (2002).

3.1.3.3 Tsunamis and Seiches

Both tsunamis and seiches are possible in this area (MMS 1995). Tsunamis can be generated when large volumes of sea water are displaced by tectonic movement of the seafloor, volcanism, landslides, or large rock falls and are possible in the Cook Inlet area (MMS 1995). Tsunamis pose a hazard for both shoreline and offshore facilities. Seiches start in partially or completely enclosed waterbodies and are caused by seismic activity or by large rock slides or landslides in coastal areas (MMS 1995).

3.1.3.4 Seafloor Stability

Cook Inlet surface sediments, ranging from sandy silt to gravel with low accumulation rates and gently seafloor slopes in upper Cook Inlet to a steeply sloping seafloor in lower Cook Inlet. The seafloor appears to pose no significant geotechnical problems and possess preferred engineering conditions (MMS 1995). No evidence of gravitationally unstable slopes or soft, unconsolidated sediment has been found (MMS 1995). Mean grain size in the inlet generally decreases from north to south, with sand-sized sediment most abundant in the central inlet area (MMS 1995). Measurements of vane shear strength, water content, and plasticity of the shallow marine sediments indicate no unusual geotechnical problems (MMS 1995).

High currents present in Cook Inlet result in the formation of sand, gravel, and cobble wave-like bottom features. These features are believed to be somewhat mobile and are documented to exist in both the upper and lower inlet. The heights of these features are commonly 5 to 10 feet, but higher waves have been documented. The primary hazard associated with pipelines through these features is the creation of long spans of unsupported pipe subjected to vibrations and possible failure (SAIC 2002).

Large boulders are common to upper Cook Inlet. Under high currents, they can be undermined, possibly creating a hazard to pipelines (SAIC 2002).

3.1.3.5 Shallow, High-Pressure Gas Deposits

Shallow (1,000 to 2,000 feet), high-pressure natural gas deposits are common in upper Cook Inlet. These deposits can cause problems for drilling operations. Over the past two decades, drilling operations encountering shallow, high-pressure gas deposits have resulted in at least two offshore blowouts. In May 1985, Grayling Platform experienced a short-term blowout. In December 1987, the Steelhead Platform had a blowout that lasted over 6 months (SAIC 2002).

3.2 CLIMATE AND METEOROLOGY

In the lower Cook Inlet region, the climate is transitional from a maritime to a continental climate. Generally, lower Cook Inlet is a maritime climate, wetter and warmer than the upper Cook Inlet region, which exhibits some continental climatic features; that is, the upper Cook Inlet region is drier and cooler than the lower (MMS 2003).

Six Gulf of Alaska weather types influence lower Cook Inlet. The Aleutian low-pressure center occurs most often. The Aleutian Low, a semipermanent low-pressure system over the Pacific Ocean, has a strong effect on the climate in the area. As this low-pressure area moves and changes in intensity, it brings storms with wind, rain, and snow (MMS 2003). The other weather types are the low-pressure center over central Alaska; the stagnating low off the Queen Charlotte Islands; and the Pacific Anticyclone, also known as the East Pacific High (MMS 2003). Generally, winter is characterized by an inland high-pressure cell with frequent storm progressions from the west along the Aleutian chain. During summer, a low-pressure cell is over the inland area, with fewer storms. Spring and fall are characterized by a transition between these generalized patterns (MMS 2003).

3.2.1 Air Temperature

Monthly average air temperatures for the Cook Inlet lease-sale area rise above freezing from mid-April to the end of October. Even during these months, air temperature on any day can vary from near 0 to 20 °C. July typically is the warmest, with an average air temperature of about 12–19 °C onshore and 11–13 °C offshore. December through February usually are the coldest months. Air temperatures typically remain below freezing for 4 months of the year. Superstructure icing can occur throughout the lower Cook Inlet region (MMS 2003).

3.2.2 Precipitation

Precipitation decreases from south to north along the inlet. Kodiak is the wettest, and Anchorage is drier. Homer, Kenai, and Anchorage all have substantially less precipitation than Kodiak because of the sheltering or "rain shadow" effect of the Kenai Mountains. Homer averages about 65 centimeters of precipitation annually, and Anchorage averages about 40 centimeters. The wettest months are September and October; the relatively dry conditions occur from April through July. In the northern inlet, precipitation usually falls as snow from October to April and as rain the rest of the year. Farther south in the inlet, a greater percentage of the precipitation falls as rain.

3.2.3 Winds

The *atmospheric forcing* is influenced by storm systems. These storms have lives of a few days, but their frequency and intensity vary across time scales of weeks to decades (MMS 2003). Winds in lower Cook Inlet respond to the large-scale weather patterns but with important modifications caused by the topography of the surrounding mountains (MMS 2003). The rough terrain encircling the inlet on three sides often interacts with larger-scale winds and pressure gradients to produce highly variable wind regimes on scales of a few kilometers.

Cook Inlet is framed by mountains on the east and west with only small breaks. On the western side of Cook Inlet are the Alaska and Aleutian (Alaska Peninsula) ranges; on the eastern side are the Talkeetna, Chugach, and Kenai mountains and the Kodiak and Afognak Islands lesser ranges. The nearly continuous Alaska Peninsula mountains act as a barrier to winds broken only by Kamishak Gap, a low-lying area between Iliamna Lake and Kamishak Bay. The Kennedy and Stevenson entrances in lower Cook Inlet are major breaks in the eastern mountains from the Kenai Peninsula to the Kodiak-Afognak Islands Group. The inlet's and strait's mountainous borders not only block low-level airflow east and west but also form airflow channels north and south (MMS 2003).

There are two main types of winds: gap winds and drainage winds. Gap winds can be subdivided further into mountain (orographic) channeling and mountain gap winds. A gap wind is a wind flowing from areas of high-pressure systems to areas of low-pressure systems along the sea-level channel. Gap winds are observed over Cook Inlet (MMS 2003).

The mountain-channeled winds are influenced by small-scale features such as drainage winds (a cold air mass moving downslope) and wake flow. Drainage winds occur along Cook Inlet's mountainous southeastern and western coasts draining from glaciated valleys. Kachemak Bay exhibits drainage winds because several Kenai Peninsula glaciers terminate at its eastern end. In winter, cold continental air drains from the mountainous regions surrounding northern Cook Inlet. Drainage wind velocities can exceed 50 meters per second (97.2 knots) and extend for tens of kilometers offshore (MMS 2003). Wind flow around Mount Augustine has been characterized as wake flow with typical velocities of 3–8 meters per second (5.8–15.6 knots) (MMS 2003).

Storm-surge development is unfavorable in most of lower Cook Inlet because of the rugged topography and steeply sloping seafloor. However, the open-water stretch from Shelikof Strait to lower Cook Inlet can develop storm surges with west-southwest winds during the fall and winter, when wind strength is sufficient (MMS 2003).

3.2.4 Air Quality

Air quality in the project area is generally considered to be good. Several industrial and energy facilities onshore and offshore emit air pollutants, including particulate matter (PM), sulfur oxides (SO_X), carbon monoxide (CO), nitrogen oxides (NO_X), and volatile organic compounds (VOCs). Impacts from these emissions tend to be localized. The largest sources of emissions are in the industrial areas and population centers of Kenai (Nikiski) and Anchorage (SAIC 2002).

One year of ambient air quality data was collected during 1993 and 1994. A monitoring station, established on the west shore of Cook Inlet near Beluga, collected information on CO, hydrogen sulfide (H_2S), O_3, NO_X, sulfur dioxide (SO_2), total suspended particulate matter (TSP), and respirable particulate matter with an aerodynamic diameter of less than or equal to 10 microns (PM_{10}). These data are summarized in Table 3-2.

Table 3-2. Summary of Baseline Air Quality Data (Beluga Area, July 1993 to September 1994)

Parameter	Concentration (µg/cm^3)	National Ambient Air Quality Standard (µg/cm^3)
NO_2 - Annual Mean	1.9	100
O_3		
Maximum 1-hour	104	235
Second Highest 1-hour	102.1	---
Annual Mean	52.6	No Standard
SO_2		
Maximum 3-hour	13.1	1,300
Second Highest 3-hour	10.5	---
Maximum 24-hour	5.2	365
Second Maximum 24-hour	5.2	---
Annual Mean	2.6	80
H_2S		
Maximum 1-hour	8.4	No Standard
Second Highest 1-hour	8.4	---
Annual Mean	1.4	No Standard
CO		
Maximum 1-hour	3,092	40,000
Second Highest 1-hour	2,634	---
Maximum 8-hour	1,489	10,000
Second Highest 8-hour	1,489	---
PM-10 (Beta Gauge)		
Maximum 24-hour[a]	32	150
Second Highest 24-hour[a]	32	---
Annual Average[b]	6.5	50

Table 3-2. Summary of Baseline Air Quality Data (Beluga Area, July 1993 to September 1994) (Continued)

Parameter	Concentration (μg/cm^3)	National Ambient Air Quality Standard (μg/cm^3)
PM-10 (Hi-Vol)		
Maximum 24-hour	14.9	150
Annual Average	4.6	50

Source: SAIC (2002).

[a] This value reflects a measurement from midnight to midnight, not a 24-hour running average.

[b] Annual average of hourly data from beta gauge.

The air quality standards for Cook Inlet fall under EPA established National Air Quality Standards (NAAQS) for NO_X, CO, ozone (O_3), SO_2, and PM_{10} (Table 3-2). The Alaska Department of Environmental Conservation (ADEC) has not established more stringent air quality standards. As shown in Table 3-2, the ambient concentrations of regulated air pollutants in the project's vicinity are well below the applicable NAAQS, and the air quality is generally considered good (SAIC 2002).

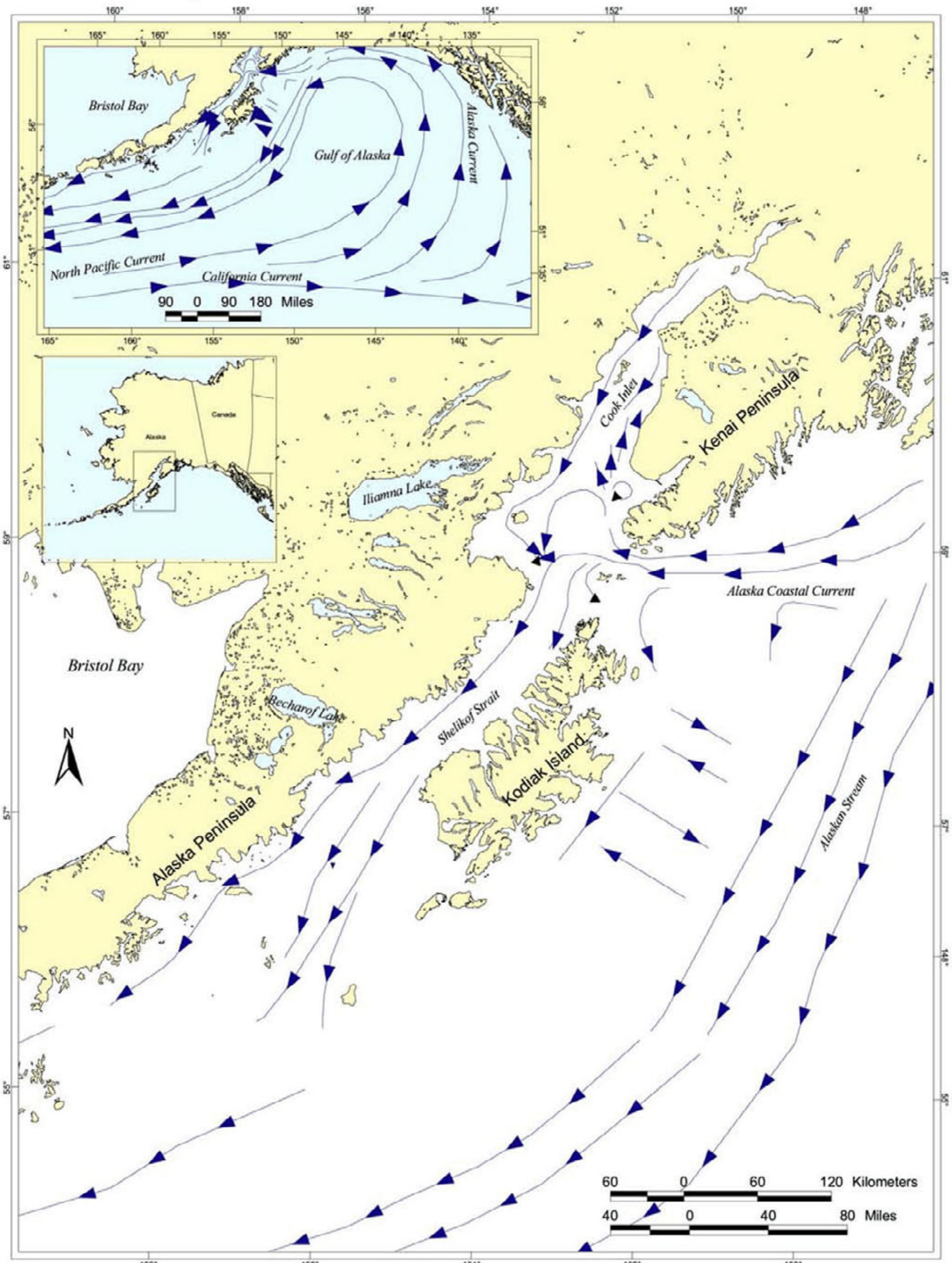
Air quality impacts from offshore industrial facilities are localized, and the greater emissions are from land-based industrial areas and population centers. The Prevention of Significant Deterioration (PSD) Program of the Clean Air Act governs the operation of all new stationary sources of discharge in compliance with NAAQS in the Cook Inlet area. Areas in Alaska are designated as PSD Class I or Class II. The Class I air quality designation is the most restrictive and applies to certain national parks, monuments, and wilderness areas. Tuxedni National Wildlife Refuge (about 50 miles from the project site) is designated as a National Wilderness Area and is the only Class I area in the general Cook Inlet area; the remaining areas are designated as Class II (SAIC 2002).

3.3 OCEANOGRAPHY

Lower Cook Inlet circulation is affected by its location within the Gulf of Alaska. The lower Cook Inlet connects to the Gulf of Alaska through the Kennedy and Stevenson entrances and Shelikof Strait. The generalized regional circulation is shown in the inset in Figure 3-2. Note that the no discharge zones associated with Turnagin Arm and Knik Arm are also shown on Figure 2-2.

The easterly flowing North Pacific Current divides into the north-flowing Alaska Current and the south-flowing California Current. In the eastern Gulf of Alaska, the Alaska Current forms an approximately 400-kilometer-wide, offshore, counterclockwise flow, with surface velocities of approximately 30 centimeters per second. In the western Gulf of Alaska, where the current is named the Alaskan Stream, the width decreases to less than 100 kilometers and surface velocities increase, ranging up to 100 centimeters per second (MMS 2003). The Alaskan Stream volume transport is 12–15 million cubic meters per second and shows no significant seasonal variation (MMS 2003).

Figure 3-2. Schematic of Mean Spring-Summer Surface Circulation in Lower Cook Inlet; Shelikof Strait Region.



(Source: MMS 2003)

The lower portion of Cook Inlet is influenced by the Alaskan Stream and by a parallel current in the western Gulf of Alaska called the Kenai Current or the Alaska Coastal Current. The Alaska Coastal Current flows along the inner shelf in the western Gulf of Alaska and enters Cook Inlet and Shelikof Strait (MMS 2003). The current is narrow (less than 30 kilometers) and high-speed (20–175 centimeters per second) with flow that is driven by fresh water discharge and inner-shelf winds (MMS 2003). Peak velocities of 175 centimeters per second occur in September through October (MMS 2003). The Alaska Coastal Current transport volume ranges from 0.1 to 1.2 million cubic meters per second and varies seasonally in response to fresh water runoff fluctuations, regional winds, and atmospheric pressure gradients (MMS 2003). Oxygen isotope measurements in late summer show that glacial meltwater may provide much of the total fresh water runoff into the Alaska Coastal Current (MMS 2003).

3.3.1 Bathymetry

Cook Inlet is a tidal estuary with a northeast to southwest orientation. It is roughly 180 miles (290 kilometers) long and averages 60 miles (96 kilometers) wide. The East and West Forelands divide Cook Inlet into the upper and lower inlets. Upper Cook inlet is about 17 to 19 miles (11 to 14 kilometers) wide. Water depths are typically 100 to 200 feet (30 to 60 meters) but can be 500 feet (152 meters) in channels near the Forelands (EPAI 2002). Lower Cook Inlet narrows to about 86 miles (140 kilometers), with depths greater than 240 meters (MMS 2003).

A traditional ecological knowledge (TEK) interviewee expressed concern that over time platform discharges have caused changes to the bathymetry of the inlet floor and associated habitat (clam beds, vegetation, bottom fish) due to production-phase discharges (SRB&A 2005).

3.3.2 Lower Cook Inlet

3.3.2.1 Circulation

This section describes the generalized mean circulation in lower Cook Inlet. A southward flow along western lower Cook Inlet is caused by the Coriolis force's acting on fresh water entering upper Cook Inlet from rivers. The three primary rivers are the Susitna, Matanuska, and Knik rivers, which have a combined peak discharge of about 90,000 cubic meters per second that occurs in July through August (MMS 2003). Northern Cook Inlet's salinity, temperature, and suspended-sediment concentrations change significantly with the seasons and reflect variations in the upper Cook Inlet freshwater input (MMS 2003).

The Alaska Coastal Current and deeper water enter Cook Inlet from the Gulf of Alaska through Kennedy and Stevenson entrances, then flow northward along the eastern side of the inlet as well as westward along the 100-meter isobath, turning south near Cape Douglas (MMS 2003). Westerly mean flow during winter is approximately 20 centimeters per second with south flow approximately 5–10 centimeters per second (MMS 2003). In summer, westerly flow is slower and southerly flow is faster (MMS 2003). Surface circulation is controlled by the seasonally varying fresh water outflow, with Alaska Coastal Current water traveling farther north during periods of less freshwater input (MMS 2003).

The relatively fresh, turbid upper Cook Inlet outflow meets and mixes with incoming Alaska Coastal Current water in the central inlet. This mixture flows along the western Cook Inlet and flows to the Shelikof Strait (MMS 2003). During fall and winter, when fresh water inputs to Cook Inlet are lower, a clockwise gyre can develop around Kalgin Island, lengthening water retention time in the upper inlet (MMS 2003).

TEK interviewees stated concerns about the possibility of platform discharges concentrating in the water due to the ‘static’ nature of current and tidal patterns in Cook Inlet where the tides do not flush the water immediately, as evidenced by observations of materials remaining in relatively fixed locations for successive tidal cycles (SRB&A 2005).

The instantaneous current field is characterized by wind-driven currents and tidal currents that vary from prominent (principal lunar component M2 amplitude of 80 centimeters per second) in the eastern lower inlet to weaker (M2 amplitude of 40 centimeters per second) in the central and western inlet (MMS 2003).

3.3.2.2 Tides

In Cook Inlet, mixed tides are the main surface circulation driving force. Two unequal high and low tides occur per tidal day with the mean range increasing northward. Mean diurnal range is 5.8 meters (19.1 feet) on the east side of the inlet and 5.1 meters (16.6 feet) on the west (MMS 2003). Tidal currents reach 102–153 centimeters per second in the lower Cook Inlet entrance, and speeds greater than 335 centimeters per second occur at the narrows (MMS 2003).

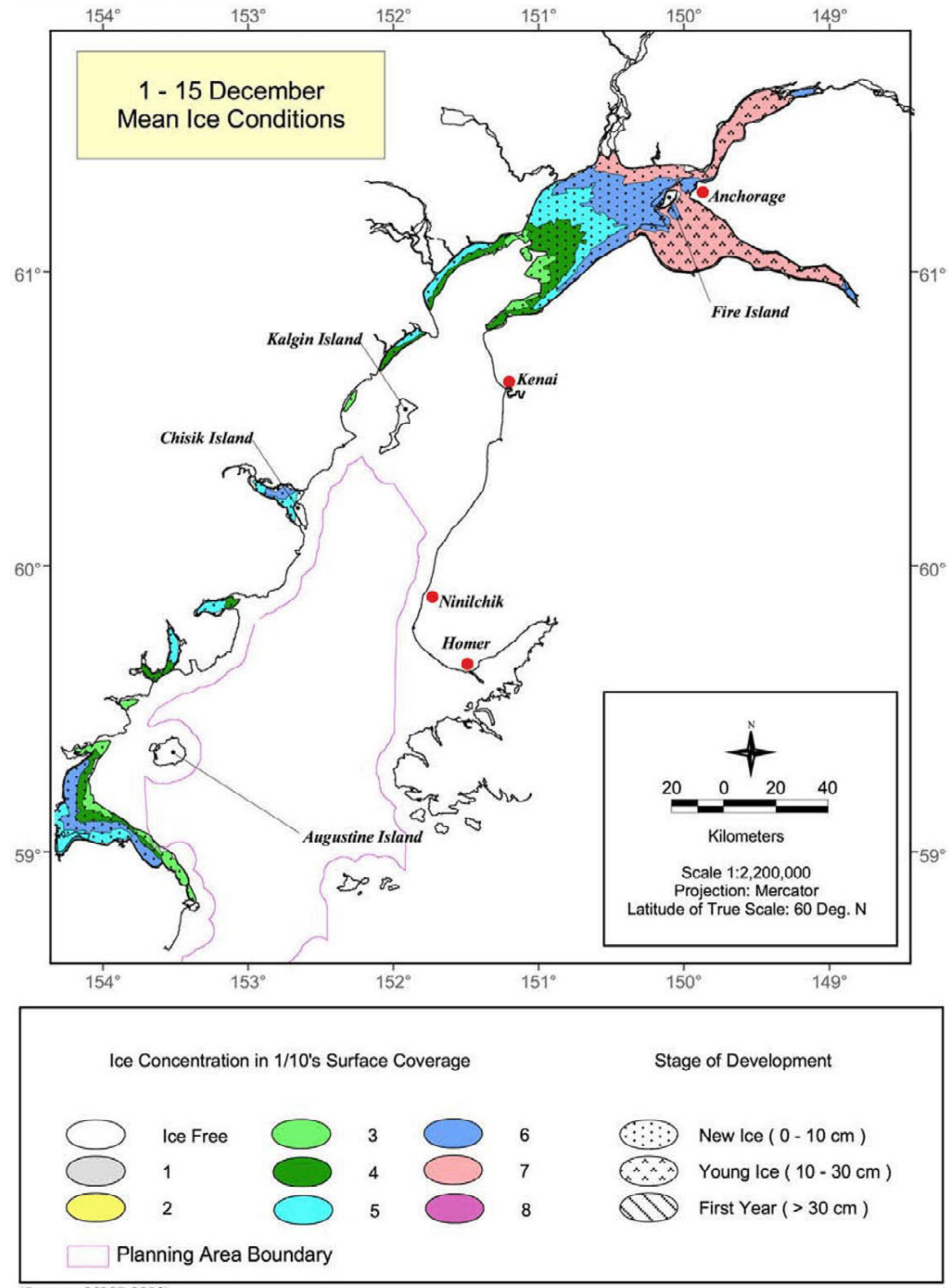
3.3.2.3 Upwelling, Fronts, and Convergences

Upwelling occurs along the outer Kenai Peninsula coast northwest of the Chugach Islands. The upwelled water enters Kachemak Bay, promoting high productivity. Fronts occur as Gulf of Alaska water encounters fresh water outflow from the upper inlet. These zones, termed “rips,” are convergence zones and locations of debris accumulation. Although the number of recorded observations is small, downward velocities as high as 10 centimeters per second have been measured, which are fast enough to temporarily and locally overcome the buoyancy of surface debris or oil (MMS 2003).

3.3.2.4 Sea Ice

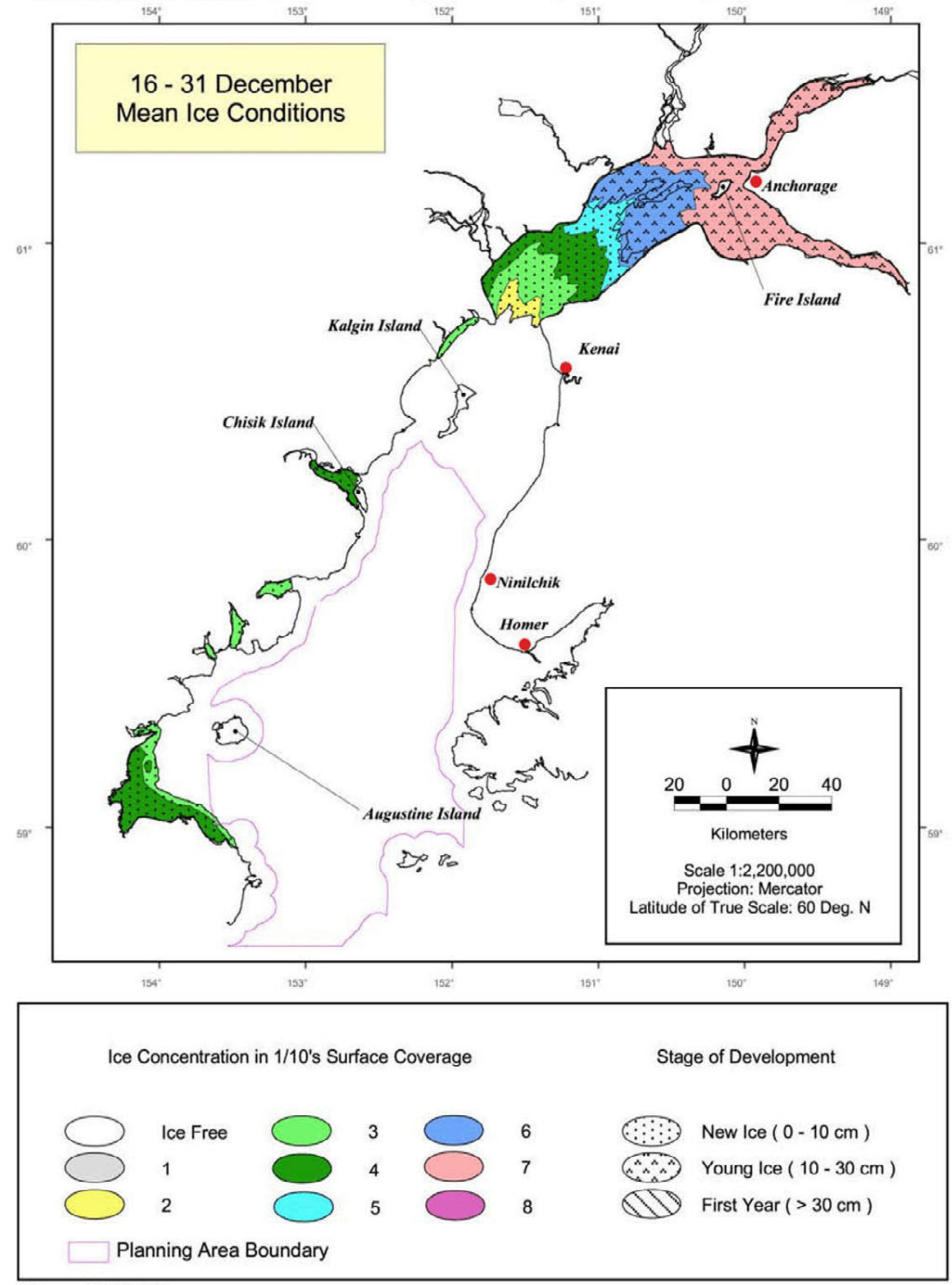
Pack ice, shorefast ice, stamukhi (i.e., layered “ice-cakes” formed by the stacking of ice floes on shorefast ice over multiple high tides), and estuarine/river ice are the four ice types in Cook Inlet. Sea ice is most prevalent in the lease-sale area during winter. In Cook Inlet, the amount of sea ice varies annually. In general, sea ice forms in October and November, increases from October to February from the West Foreland to Cape Douglas, and melts in March to April (Figures 3-3 to 3-10). Sea ice formation is controlled in upper Cook Inlet primarily by air temperature and in lower Cook Inlet by the temperature and inflow rate of the Alaska Coastal Current (MMS 2003).

Figure 3-3. Mean Ice Concentration and Stage of Development for Cook Inlet for December 1-15.



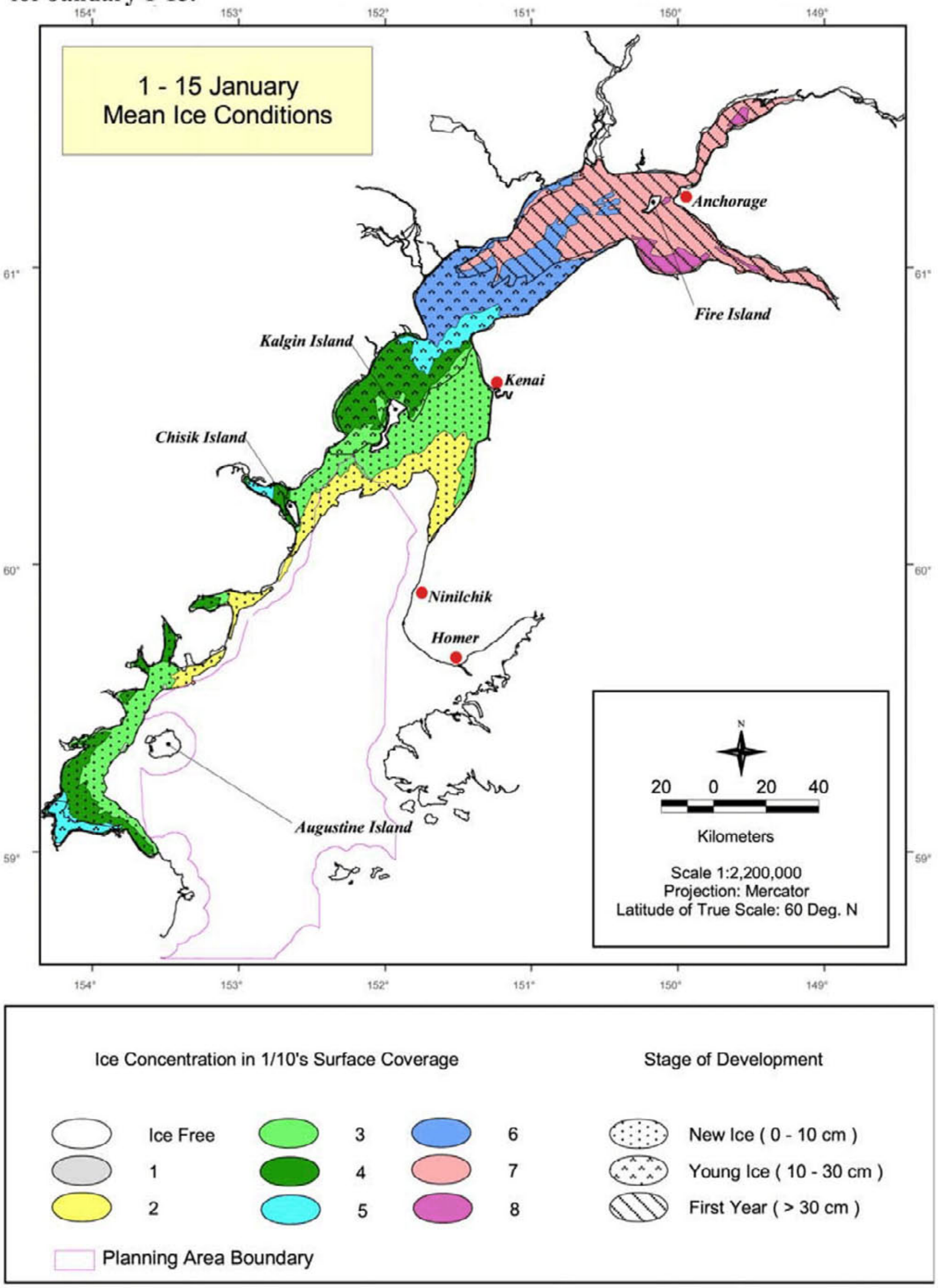
(Source: MMS 2003)

Figure 3-4. Mean Ice Concentration and Stage of Development for Cook Inlet for December 16-31.



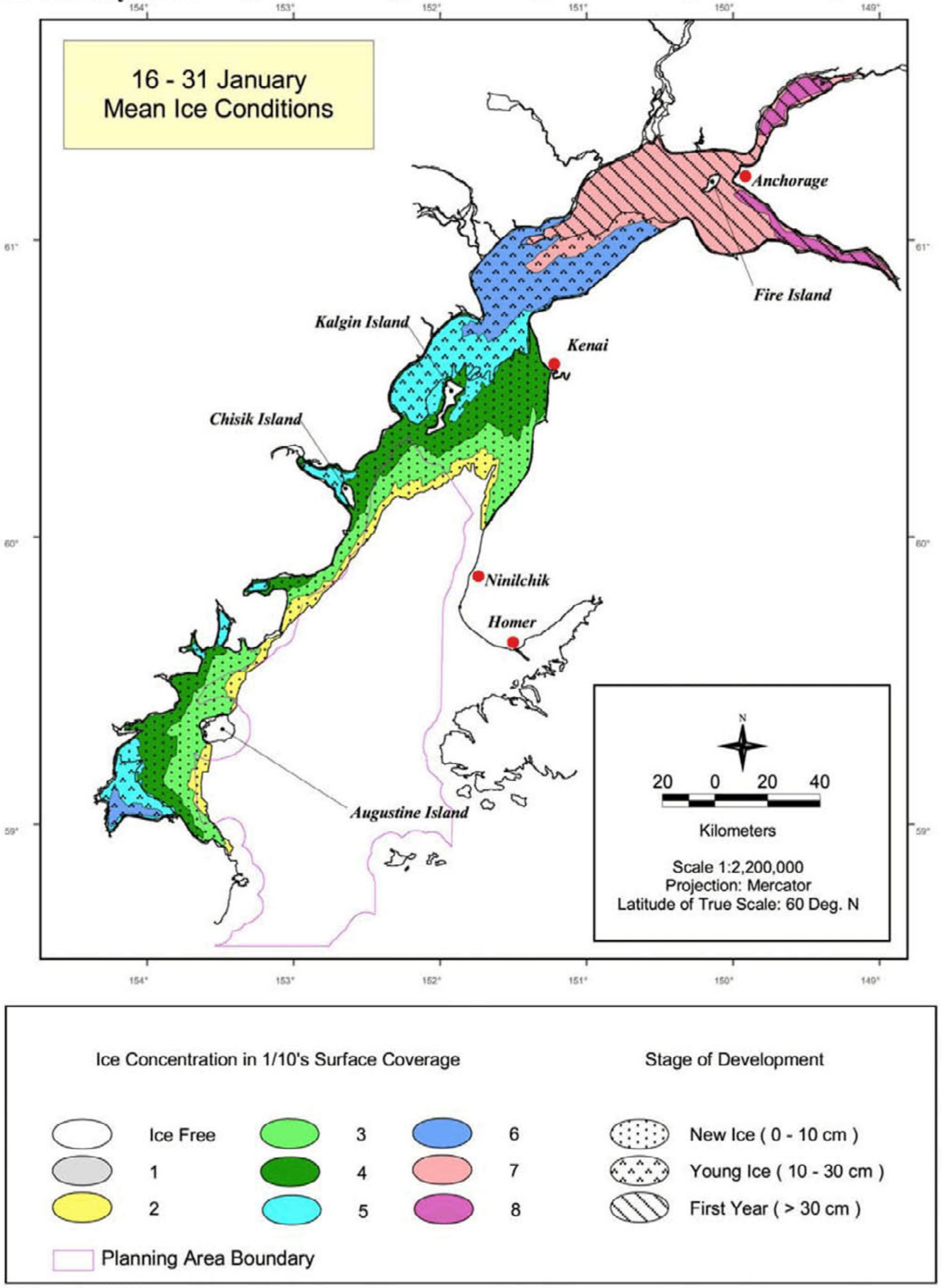
(Source: MMS 2003)

Figure 3-5. Mean Ice Concentration and Stage of Development for Cook Inlet for January 1-15.



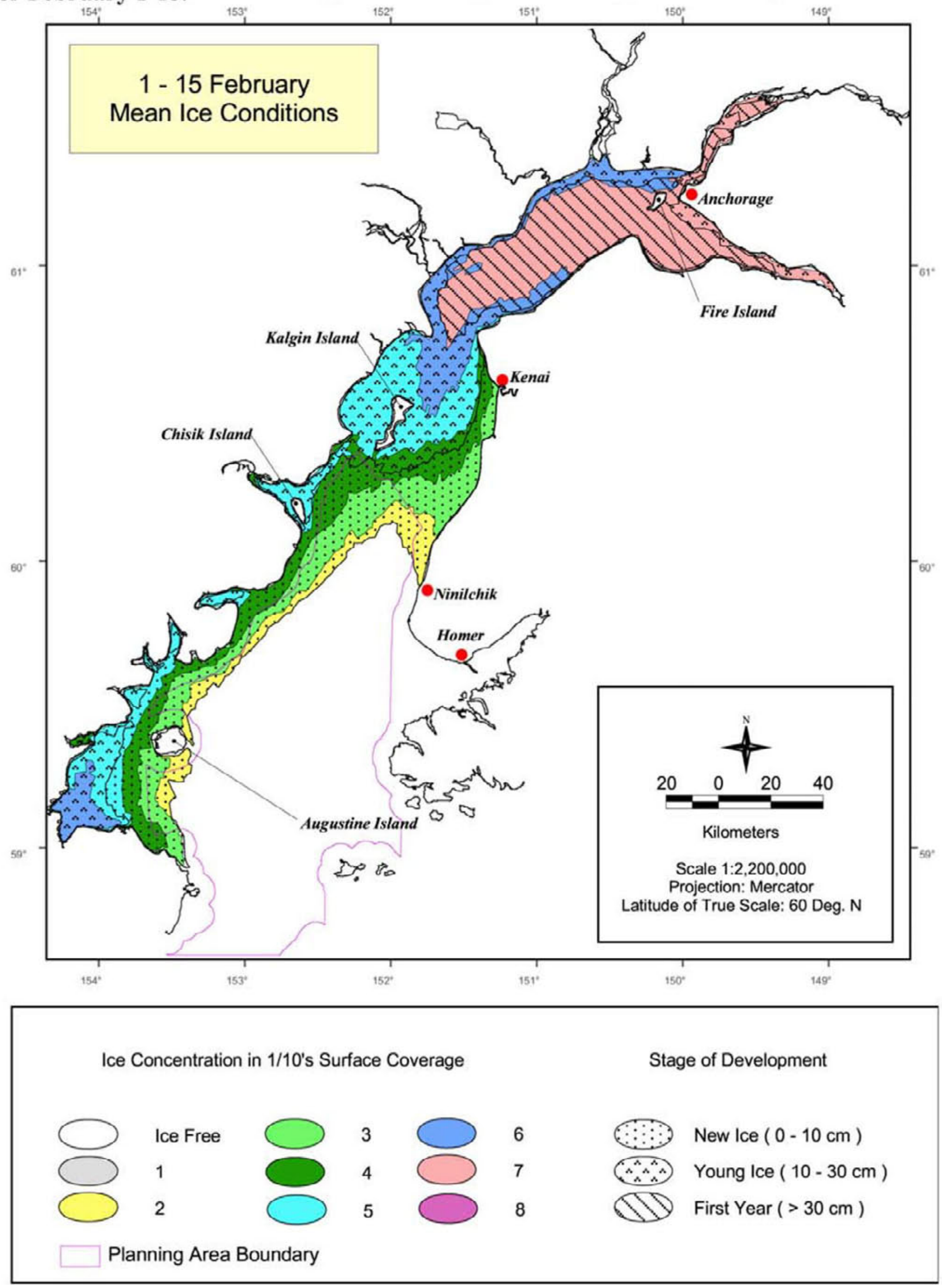
(Source: MMS 2003)

Figure 3-6. Mean Ice Concentration and Stage of Development for Cook Inlet for January 16-31.



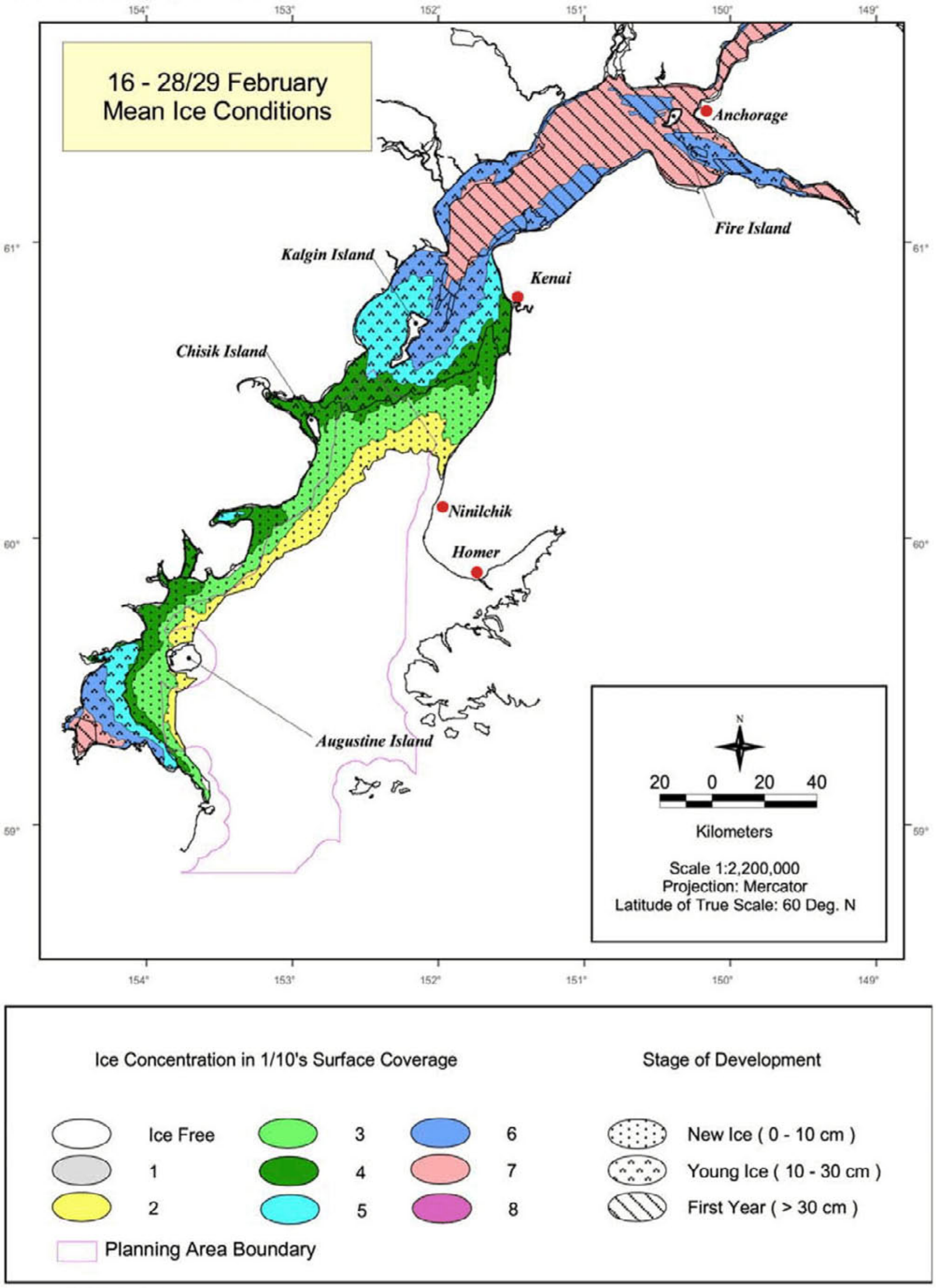
(Source: MMS 2003)

Figure 3-7. Mean Ice Concentration and Stage of Development for Cook Inlet for February 1-15.



(Source MMS 2003)

Figure 3-8. Mean Ice Concentration and Stage of Development for Cook Inlet for February 16-28/29.



(Source: MMS 2003)

3.3.2.5 Water Temperature

Temperature varies from approximately 11 °C at the entrance of lower Cook Inlet to approximately 10 °C between the Forelands. Western Cook Inlet water is cooler in the spring and warmer in the fall than incoming oceanic water from the Gulf of Alaska (MMS 2003).

3.4 MARINE WATER QUALITY

The water quality in Cook Inlet is influenced by tidal turbulence and determined by the water's chemical and physical characteristics. Naturally occurring and man-made substances enter Cook Inlet waters and are diluted and dispersed by the currents associated with the tides, estuarine circulation, wind-driven waves and currents, and Coriolis force (MMS 2003). On the basis of standard salt balance calculations, 90 percent of waterborne contaminants would be flushed from the inlet in 10 months (MMS 2003). Because tidal turbulence is the major mixing factor in Cook Inlet, rather than seasonally varying fresh water input, this flushing rate is relatively invariant from season to season. However, some of the persistent contaminants can accumulate in the food chain and exceed toxic thresholds, especially in predators near the top of the food chain; they can also accumulate in the seafloor sediments (MMS 2003).

The water quality of lower Cook Inlet generally is good. Cook Inlet is a relatively large tidal estuary with a sizable tidal range. The turbulence associated with mainly tidal currents but also winds results in the vertical mixing of the waters. A relatively large volume of water and a large variety of naturally occurring inorganic and organic substances are transported into Cook Inlet by the streams and rivers and by currents from the Gulf of Alaska; the amounts of the individual substances discharged into the inlet appear to be quite variable. Substances transported into Cook Inlet that remain in suspension or dissolved in the water column are dispersed by tidal currents and winds.

TEK interviewees noted that although Cook Inlet does flush periodically, the patterns of Inlet currents and tides suggest that discharges from the platforms may remain in Cook Inlet for considerable periods and much detritus accumulates in the middle rip [current] (SRB&A 2005). Tyonek interviewees also noted occasional 'small sheens' from what they suspect is oil or fuel on the water over the past several years, although they do not know the source of these occurrences (SRB&A 2005).

3.4.1 Salinity

The salinity of Cook Inlet waters is influenced by both marine and riverine input; it varies seasonally and within the tidal cycle, especially near the mouths of major rivers. In the lower inlet near the Forelands salinities are generally higher than in the upper inlet where the water is more brackish (SAIC 2002). During the summer salinities range from 20 parts per thousand (ppt) to 25 ppt near the Forelands. Salinities are higher in the winter (27 ppt to 31 ppt) when fresh water inflows are lowest. In the upper inlet near Anchorage where fresh water inputs are greatest, salinities range from 6 ppt to 15 ppt during the late summer (SAIC 2002).

3.4.2 Oxygen, Phosphate, Nitrate, Nitrite, Ammonia, and Silicate in the Water Column

The concentration of oxygen in the surface waters of Cook Inlet ranges from about 7.6 milligrams per liter in the northern part to 10 milligrams per liter in the southwestern part; none of the waters in the inlet are oxygen-deficient (MMS 2003). Other chemical parameters (and their concentration ranges) are phosphate (0.31–2.34 parts per billion [ppb]), nitrate (0–23.5 ppb), nitrite (0.02–0.52 ppb), ammonia (0.2–3.1 ppb), and silicate (9–90 ppb). In general, the concentration of phosphate increases toward the mouth of Cook Inlet, while the concentrations of nitrate and silicate decrease; the silicate concentration appears to be directly related to the suspended-sediment load (MMS 2003).

3.4.3 Suspended Sediments

Concentrations of suspended sediments in upper Cook Inlet are higher than those in the lower inlet. Suspended particulate matter derived from glacier-fed rivers flows into Cook Inlet; tidal currents are major factors affecting sediment distribution and suspension. Near Anchorage, suspended sediments can exceed 2,000 milligrams per liter (mg/L), whereas near the Forelands, suspended sediment concentrations commonly range from 100 to 200 mg/L (MMS 2003). In the Shelikof Straight, suspended sediments range from 0.3 to 2 ppm (Hampton et al. 1986, as cited in MMS 2003).

3.4.4 Sources of Contamination

The principal sources of contaminants entering the marine environment are the following:

- Discharges from municipal wastewater treatment systems
- Industrial discharges that do not enter municipal wastewater systems (petroleum industry and seafood processing)
- Runoff from urban, agricultural, and mining areas
- Accidental spills or discharges of crude or refined petroleum and other substances

Many contaminants in Cook Inlet waters are derived from various types of runoff originating from multiple, diffuse sources of pollution, primarily from urban areas and communities, farms, and mining areas.

The principal point sources of contaminants in Cook Inlet are the discharges from municipal wastewater treatment plants, seafood processors, and the petroleum industry. Estimates of the annual suspended solids discharged from the municipalities (2.03 thousand tonnes), refinery (0.03 thousand tonnes), and drilling fluids and cuttings (0.93 thousand tonnes) are only a fraction of the suspended sediments (36,343 thousand tonnes) discharged by the Knik, Matanuska, and Susitna Rivers. Estimates of the annual discharge of biochemical oxygen demand or organic wastes from municipalities (4.27 thousand tonnes), seafood processors (2.52 to 8.58 thousand tonnes), and produced waters from the petroleum industry (3.67 thousand tonnes) are all about the same order of magnitude. Estimates of discharge of several metals in municipal discharges, drilling fluids, and produced waters are small compared with river input.

Table 3-3. Oil and Gas Production Facilities in the Cook Inlet Region

Facility Name	Operator	Facility Type	Latitude/ Longitude	Distance to Shore (km/st.mi)[d]	Water Depth (meters MLLW)	Number of Oil Service Wells	Number of Gas Wells	Oil Production (bpd)	Gas Production (1,000xCFD)	Mud and Cuttings (bbl/well)	Produced Water (bbl/day)		Produced Water Discharge Location
											Peak	Avg.	
Anna	Unocal	Production Platform	60°51'37"N 151°18'46"W	4.0/2.5	23	20 oil, 8 injection	0	2,700	210	15,000	2000	1500	Platform
Baker	Unocal	Production Platform	60°49'45"N 151°29'01"W	12.1/7.5	31	11 oil, 4 service	1	1,000	280	26,000	55	30	Platform
Bruce	Unocal	Production Platform	60°59'46"N 150°17'52"W	2.4/1.5	19	11 oil, 8 injection	0	600	370	15,000	700	160	Platform
Dillon[a]	Unocal	Production Platform	60°44'08"N 151°31'45"W	6.0/3.7	28	10 oil, 3 service	0	400	150	27,000	3000	2650	Platform
NCIU Tyonek "A"	Phillips	Production Platform	61°04'36"N 151°56'54"W	8.9/5.5	21	0	12	0	165,000	NA	185	170	Platform
SWEPI "A"	Shell Western	Production Platform	60°47'45"N 151°29'44"W	9.5/5.9	30	16	1	3,100	1,000	NA	2700	1700	E. Foreland Facility
SWEPI "C"	Shell Western	Production Platform	60°45'50"N 151°30'08"W	7.1/4.4	21	15	0	3,000	1,000	11,600	2000	1000	E. Foreland Facility
Granite Point	Unocal	Production Platform	60°57'30"N 151°19'53"W	5.8/3.6	23	11 oil, 6 water injection	0	2,600	1,000	26,500	1000	300	Granite Pt. Facility
Spark[b]	Marathon	Production Platform	60°55'42"N 151°31'50"W	2.9/1.8	18	4 with 1 shut-in	0	300	NA	NA	5000	3900	Granite Pt. Facility
Spurr[c]	Marathon	Production Platform	60°55'10"N 151°33'26"W	2.6/1.6	20	5, with 1 shut-in	1 shut-in	300	NA	NA	500	200	Granite Pt. Facility
Grayling	Unocal	Production Platform	60°50'13"N 151°36'47"W	5.8/3.6	41	24 oil, 10 service, 1 abandoned	2	6,800	9,200	20,000	39000	37000	Trading Bay Facility
Dolly Varden	Unocal	Production Platform	60°48'28"N 151°37'58"W	6.4/4.0	34	24	1, with 1 shut-in	6,700	Platform use only	13,500	33800	31300	Trading Bay Facility
King Salmon	Unocal	Production Platform	60°51'54"N 151°36'18"W	3.9/2.4	24 (MSL)	19	1	5,000	6,000	15,000	42000	40300	Trading Bay Facility
Monopod	Unocal	Production Platform	60°53'49"N 151°34'44"W	2.4/1.5	19	29 oil, 2 service	0	2,800	2,500	5,800	6,000	4800	Trading Bay Facility
Steelhead	Unocal	Production Platform	60°40'54"N 151°36'08"W	7.1/4.4	56	3	11	2,000	165,000	13,500	1000	800	Trading Bay Facility
Osprey	Forest Oil	Production Platform	60°41'46"N 151°40'10"W	2.9/1.8	14	In develop-ment	In develop-ment	In develop-ment	In development	In development[g]	In dev.	In dev.	To be Reinjected
Granite Point[c]	Unocal	Onshore Separation	60°01'14"N 151°25'14"W	3.1/1.9[e]	14[f]	NA	NA	NA	NA	NA	5200	4400	Spark Platform
Trading Bay	Unocal	Onshore Separation	60°49'05"N 151°46'59"W	3.1/1.9[e]	11[f]	NA	NA	NA	NA	NA	1.2E5	1.15E5	Outfall
East Forelands	Shell Western	Onshore Separation	60°44'09"N 151°21'13"W	0.24/0.15[e]	11[f]	NA	NA	NA	NA	NA	5000	3100	Outfall

Source: MMS (2002).

[a] Shut down June 1992 (MMS 2003).
[b] Shut down January 1992 (MMS 2003).
[c] Shut down May 1992 (MMS 2003).
[d] Distance from nearest shore measured from low water mark in kilometers/statute miles.
Notes: bpd (barrels per day); CFD (Cubic feet per day); bbl (barrels)

[e] Distance of discharge point from shore
[f] Water depth at location of discharge outfall.
[g] Muds and cuttings to be injected into underlying formation.

3.4.4.1 Petroleum Industry

The activities associated with petroleum exploitation that are most likely to affect water quality in the Cook Inlet lease-sale area are (1) the permitted discharges from exploration-drilling units and production platforms, and (2) petrochemical-plant operations. Into 2002, there were 15 oil-production platforms and 1 gas-production platform operating in upper Cook Inlet (Table 3-3). In addition, there were 3 production-treatment facilities onshore; produced waters from 10 of the oil-production platforms are treated at these facilities. (In 1992, three oil-production platforms and one production-treatment facility were shut down.) In 2000, the oil-production platforms produced about 9 million barrels of oil and 47 million barrels of produced water (MMS 2003).

Exploration and Production Discharges

Petroleum-production operations in upper Cook Inlet discharge a large volume of water and a variety of chemicals used to conduct the various operations associated with petroleum exploration and production. The characteristics of the produced waters, as well as other discharges (except drilling fluids and cuttings) described in this section, are from information obtained during the part of the Cook Inlet Discharge Monitoring Study that was conducted between April 10, 1988, and April 10, 1989 (MMS 2003). The monitoring program used to develop the current general NPDES permit for oil and gas exploration, development, and production facilities in Cook Inlet is described in Permit No. AKG285000 (EPAI 1999).

Produced Water

From the 1960s to the end of 2001, approximately 1,030 million barrels of oil and 978 million barrels of water were produced mainly from four offshore oil fields in upper Cook Inlet. Peak production from these fields occurred in 1970 when about 70 million barrels of oil were produced. By the end of 1975, about 514 million barrels of oil and 61 million barrels of water had been produced—about 50 percent of the total amount of oil and 6 percent of the total amount of water produced from the offshore platforms through 2001 (MMS 2003).

Produced water constitutes the largest source of naturally occurring and man-made substances discharged into the waters. These waters are part of the oil/gas/water mixture produced from the wells and contain a variety of dissolved substances from the geologic formation through which they migrated and in which they became trapped. These can include small quantities of naturally occurring radioactive materials (NORM), although concentrations from fresh water formations such as those that exist under Cook Inlet are usually low. In addition, chemicals are added to the fluids that are part of various activities including water flooding; well work over, completion, and treatment; and the oil/water separation process. These chemicals might include flocculants, oxygen scavengers, biocides, cleansers, and scale and corrosion inhibitors. During the 1987–1988 Cook Inlet Discharge Monitoring Study of production platforms, the types of chemicals added during the various operations ranged from less than 4 to 410 liters per day per platform. The discharge of produced waters is of concern because of the types and amounts of naturally occurring substances they might carry and man-made substances that might be added (MMS 2003).

Table 3-4. Chemical Analyses of Produced Water Samples: The Cook Inlet Discharge Monitoring Study

Facility	Field DO (ppm)	Field pH	Lab pH	Oil & Grease Spec (mg/L)	Oil & Grease Grav (mg/L)	BOD (mg/L)	COD (mg/L)	Salinity ‰	Ammonia N (mg/L)	TOC (mg/L)	96-hr LC_{50}	Zinc (ppm=mg/L)	TAH (ppm=mg/L)	Total Naphthalene Hydro-carbons (ppm=mg/L)
Offshore Production Treatment Facility														
Granite Point														
Mean	1.0	6.5	7.4	147.0	36.2	413	1,071	33.74	11.28	238	13.50	0.038	12.226	2.177
Minimum	0.0	6.3	7.1	25.0	24.8	340	865	31.40	9.60	224	5.81	0.025	10.028	0.357
Maximum	1.8	6.9	7.6	209.0	50.7	504	1,290	36.30	12.90	251	19.36	0.100	15.205	5.765
Trading Bay														
Mean	3.6	6.7	6.8	46.0	36.0	518	963	25.83	5.14	255	17.99	0.038	8.428	2.003
Minimum	0.1	6.5	6.5	28.0	3.2	315	731	25.10	0.82	126	9.43	0.025	6.593	0.312
Maximum	8.1	7.0	7.1	58.0	70.1	780	1,100	25.56	7.70	367	25.00	0.100	11.739	5.480
East Foreland														
Mean	0.3	7.5	7.8	12.3	18.9	470	962	20.60	10.55	306	21.66	0.101	13.091	4.190
Minimum	0.0	6.9	7.4	11.0	10.3	360	731	19.38	8.50	234	13.15	0.025	10.077	0.293
Maximum	0.8	8.5	7.9	14.0	41.4	630	1,240	21.59	13.00	393	30.88	0.170	24.044	15.525
Oil-Production Platforms														
Baker														
Mean	1.1	7.5	8.0	52.7	34.0	435	800	9.76	4.98	208	23.98	0.416	21.213	1.443
Minimum	0.6	7.0	7.8	25.2	7.7	120	400	7.76	0.05	10	8.84	0.025	8.197	0.173
Maximum	2.0	8.2	8.3	96.4	131.0	758	1,154	13.00	7.70	749	41.61	4.300	31.622	2.847
Bruce														
Mean	1.7	6.7	7.3	73.3	52.6	1,480.8	2,995.8	13.80	13.68	1,154.8	0.90	3.688	41.287	4.108
Minimum	1.4	6.1	7.1	67.0	28.5	1,170.0	2,950.0	13.50	10.90	967.0	0.27	0.430	22.130	0.764
Maximum	2.1	7.3	7.5	82.0	81.3	1,860.0	3,050.0	14.16	17.00	1,430.0	2.47	8.000	62.335	13.277
Gas-Production Platform														
Phillips "A"														
Mean	2.0	7.3	7.5	1.3	3.8	105	438	4.97	2.09	172	63.69	0.031	0.704	0.609
Minimum	1.6	6.8	7.4	0.7	1.2	58	200	0.40	1.70	86	47.56	0.025	0.358	0.078
Maximum	2.5	7.6	7.7	2.1	7.0	124	533	9.90	2.14	209	82.47	0.60	1.271	0.400

Source: MMS (2002). Notes: BOD = biochemical oxygen demand; COD = chemical oxygen demand; DO = dissolved oxygen; LC50 = lethal concentration at which half the organisms die; mg/L = milligrams per liter; N = nitrogen; ppm = parts per million; ‰ = practical salinity units (parts/thousand); TAH = total aromatic hydrocarbons; TOC = total organic carbon.

Before the produced water is discharged into the waters of Cook Inlet, it passes through separators that remove oil and gas. The treatment process removes suspended oil particles from the waters, but the effluent contains dissolved hydrocarbons or hydrocarbons held in colloidal suspension. Relative to the crude oil, the treated produced waters are enriched in the more soluble low-molecular weight saturated and aromatic hydrocarbons. As specified in the NPDES permit, the maximum daily discharge limit of oil and grease in the produced waters discharged into the inlet is 42 ppm, and the monthly average is 29 ppm (MMS 2003).

Some of the characteristics of the produced waters that were discharged into Cook Inlet during the Cook Inlet Discharge Monitoring Study are shown and described in Tables 3-4 and 3-5. The amount of oil and grease, biochemical oxygen demand, and zinc in the discharges associated with petroleum production in Cook Inlet is shown in Table 3-6; this information is from concentrations shown in Table 3-4 and produced water discharge rates in Table 3-3. The biochemical oxygen demand averaged about 10,000 kilograms per day (about 3,662 tonnes/year).

Table 3-5. Chemical Analyses of Produced Water Samples: Source Samples from Shelikof Strait Sediment Quality Study and Produced Water Samples from the Trading Bay Production Facility Outfall

Parameters	Net Weight (parts per million wet weight)
Total PAH	0.380
Total PHC	6.20
Silver	<0.0001
Arsenic	0.0024
Barium	20.7
Beryllium	<0.0001
Cadmium	0.000
Chromium	0.0032
Copper	0.0060
Iron	0.76
Mercury	<0.0005
Manganese	1.71
Nickel	0.0075
Lead	0.0001
Antimony	0.0001
Selenium	<0.0002
Tin	0.008
Thallium	0.00025
Vanadium	0.067
Zinc	0.0030

Source: MMS (2003).

Notes:
< = less than
PAH = polycyclic aromatic hydrocarbons
PHC = petroleum hydrocarbons

Table 3-6. Estimates of Oil and Grease, Biochemical Oxygen Demand, and Zinc in Cook Inlet Petroleum-Production Discharges

Facility	Produced Water Discharge Rate (bbl/day)	Oil and Grease (Galvimetric)						BOD			Zinc		
		Permit-Monthly Average			Monitoring Study			Monitoring Study			Monitoring Study		
		Concentration (mg/L)	Daily (kg)	Year (kg)	Mean Concentration (mg/L)	Daily (kg)	Year (kg)	Mean Concentration (mg/L)	Daily (kg)	Year (kg)	Mean Concentration (mg/L)	Daily (kg)	Year (kg)
Onshore Production - Treatment Facilities													
Granite Point	4,400	48	33.05	1,226	36.2	25.31	9,241	413	291.32	106,331	0.038	0.03	9.7
Trading Bay	115,000	48	877.37	320,240	36.0	658.03	240,180	518	9,468.28	3,455,922	0.038	0.69	253.5
East Foreland	3,100	48	23.65	8,633	18.9	9.31	3,399	470	231.58	84,527	0.101	0.05	18.1
Oil-Production Platforms													
Baker	30	48	0.23	84	34.0	0.16	59	435	2.07	757	0.416	0.00	0.7
Bruce	160	48	1.22	446	52.6	1.34	488	1,480.8	37.68	13,745	3.688	0.10	34.2
Gas-Production Platform													
Phillips "A"	170	48	1.29	473	3.8	0.10	37	105	2.83	1,036	0.031	0.00	0.3
Totals	122,860	NA	937.34	342,128	NA	694.26	253,404	NA	10,033.7	3,662,232	NA	0.87	312.6

Source: MMS (2003).

Notes:
bbl/day = barrels per day
BOD = biochemical oxygen demand
kg = kilogram
mg/L = milligrams per liter

The discharges included about 0.9 kilograms of zinc per day (about 0.31 tonnes per year). The amount of oil and grease discharged is about 694 kilograms per day (about 253 tonnes/year), which is about 75 percent of the monthly average specified in the NPDES permit. The Municipality of Anchorage Point Woronzof Wastewater Treatment Facility discharges about 11,670 kilograms of biochemical oxygen demand, 8 kilograms of zinc, and 2,430 kilograms of oil and grease daily. Produced water that is discharged into Cook Inlet contains a variety of hydrocarbons that includes benzene (2.280–30.200 ppm), toluene (1.050–15.800 ppm), phenol (0.0005–3.6800 ppm), naphthalene (0.0025–6.500 ppm), fluorene (0.0050–0.118 ppm), pyrene (0.005–1.240 ppm), and chrysene (0.0050–0.0500 ppm) (MMS 2003).

During the Cook Inlet Discharge Monitoring Study, the toxicity of the produced waters was determined by using a standard 96-hour static acute toxicity test (96-hour LC_{50}) on the marine invertebrate *Mysidopsis bahia* (a marine shrimp). The toxicities of the produced waters ranged from 0.27 to 82.47 percent of the effluent; these concentrations equal 2,700 to 824,700 ppm. Such concentrations are classified as toxic to moderately toxic.

Drilling Fluids and Cuttings

The NPDES general permit authorizes the discharge of water-based drilling fluids and additives. The permit prohibits the discharge of free oil and diesel oil or mineral oil based drilling fluids and limited the concentration of cadmium and mercury in stock barite that is added to drilling fluids. Drilling fluids consist of water and a variety of additives (Table 3-7); 75 to 85 percent of the volume of most drilling fluids currently used in Cook Inlet is water. When released into the water column, the drilling fluids and cuttings discharges tend to separate into upper and lower plumes (MMS 2003). The discharge of drilling fluids at the surface ensures dispersion and limits the duration and amount of exposure to organisms (MMS 2003). Most of the solids in the discharge (> 90 percent) descend rapidly to the seafloor in the lower plume. The seafloor area in which the discharged materials are deposited depends on the water depth, currents, and material particle size and density. In most areas of the outer continental shelf, the particles are deposited within 150 meters below the discharge site; however, in Cook Inlet, which is considered a high-energy environment, the particles are deposited in an area more than 150 meters below the discharge site (MMS 2003). The physical disturbance of the seafloor caused by the deposition of drilling discharges can be similar to that caused by storms, dredging, disposal of dredged material, or certain types of fishing activities. The upper plume contains the solids and water-soluble components that separate from the material of the lower plume and are kept in suspension by turbulence. Dilution rates as high as 1,000,000:1 can occur for drilling solids within a distance to 200 meters of a platform with surface currents of 30–35 centimeters per second (about 0.6–0.7 knots) (MMS 2003).

Table 3-7. Drilling Muds and Cuttings (MMS Estimates)

Weight Estimates and Composition of Drilling Muds and Cuttings		
Weight Estimates		
Well Type	**Drilling Mud Components (dry weight-tonnes)**	**Cuttings Produced (dry weight-tonnes)**
Development	70 to 340	510
Delineation	330	400
Exploration	30	400
Composition of Discharged Mud		
Component		**Weight Percent**
Barite		63.0
Clay		24.0
Lignosulfonate[a]		2.0
Lignite		1.5
Sodium Hydroxide		1.5
Other		8.0

Source: MMS (2003).

Between 1962 and 1994, about 546 wells were drilled in Cook Inlet (MMS 2003). One Continental Offshore Stratigraphic Test (COST) well and 11 exploration wells were drilled in federal waters, and 75 exploration and 459 development and service wells were drilled in state waters, mainly in upper Cook Inlet. From 1962 through 1970, 292 wells were drilled (62 exploration and 230 development and service wells). From 1971 through 1993, the number of wells drilled per year has ranged from 3 to 20; the average number drilled per year is about 11 (MMS 2003).

For the Cook Inlet sale 191 area, it is estimated that (1) the average exploration well will use about 140 tonnes of dry mud and produce approximately 400 tonnes of rock cuttings, and (2) the average development or service well will use approximately 70 tonnes of dry mud and produce about 500 tonnes of cuttings. Table 3-8 shows estimates of the amounts of drilling fluids (125,120 tonnes) and cuttings (268,900 tonnes) discharged into Cook Inlet between 1962 and 1993. The yearly discharge, assuming drilling 11 wells per year, is estimated to be about 3,690 tonnes of drilling fluids and 5,590 tonnes of cuttings. The amount of suspended sediments is estimated to be 10 percent of the discharge, or 928 tonnes (MMS 2003).

The amount of barite (barium sulfate—$BaSO_4$) in the drilling fluids is estimated to be about 63 percent (Table 3-7). Barium makes up about 59 percent of barite or about 37 percent of the drilling mud. The amount of barium that might have been discharged into Cook Inlet between 1962 and 1993 is estimated to be about 46,200 tonnes. For a single well discharging 330 tonnes of drilling fluids, the amount of barium discharged is estimated to be about 122 tonnes. EPA's limits on the amount of mercury and cadmium in the barite is 1 ppm mercury and 3 ppm cadmium (dry weight); these limits are assumed to be the concentrations of mercury and cadmium in the discharged drilling fluids. The amount of mercury and cadmium discharged per well (assuming 330 tonnes of drilling fluids per well) is estimated to be 0.12 kilograms and 0.36 kilograms, respectively. The toxicity (96-hour LC_{50}) of the fluids used to drill 39 production wells in Cook Inlet between August 1987 and February 1991 ranged from 1,955 to more than 1,000,000 ppm for *Mysidopsis bahia* (MMS 2003). The percentage of the wells with toxicities greater than 100,000 ppm was 79 percent; between 10,000 and 100,000 ppm, 10 percent; and between 1,000 and 10,000 ppm, 10 percent. Concentrations greater than 10,000 are practically nontoxic, and those between 1,000 and 10,000 are slightly toxic. The toxicity of the COST well drilling fluid discharges ranged from:

Table 3-8. Estimates of Drilling Muds and Cuttings Discharged into Cook Inlet

Well Type	Number of Wells	Drilling Muds		Drilling Cuttings	
		Amount of Muds Used per Well (tonnes)	Total Amount of Muds Used (tonnes)	Amount of Cuttings Produced per Well (tonnes)	Total Amount of Cuttings Produced (tonnes)
Exploration[a]	87	330	28,700	400	34,800
Development and Service (1966–1970)[b]	221	70	15,500	510	112,700
Development and Service[c]	238	340	80,920	510	121,400
Totals	**546**	**NA**	**125,120**	**NA**	**268,900**

Source: MMS (2003).

[a] Includes cost well.
[b] For the development and service wells drilled between 1966 and 1970, it was assumed the drilling muds were recycled, and the amount of mud used per well was 70 tonnes.
[c] For the development and service wells drilled before 1966 and after 1970, it was assumed the drilling muds were not recycled, and the amount of mud used per well was 340 tonnes.
NA = Not applicable.

- 32,000 to 150,000 ppm for shrimp
- 3,000 to 29,000 ppm for pink salmon fry
- more than 70,000 ppm to more than 200,000 ppm for amphipods
- 10,000 to 125,000 ppm for mysids.

Thus, most COST well drilling fluid discharges were practically nontoxic for a variety of marine organisms (MMS 2003).

Other Discharges

Sea water is the principal component of most of the discharges; in some cases it is the only constituent. Also, there is a wide range of concentrations of the various additives in the discharges; the rate of adding compounds to the discharge ranges from less than 4 to hundreds of liters per month, while the discharge rates of the various effluents might range from 0 (for intermittent discharges) to tens of cubic meters per day, or more. The produced water-treatment additives include biocides, scale inhibitors, emulsion breakers, and corrosion inhibitors. The range of maximum concentrations and toxicities (96-hour LC_{50}) for the various discharge components are as follows:

- Biocides are about 5 to 640 ppm (toxic to moderately toxic).
- Scale inhibitors are about 30 to 160 ppm (toxic to moderately toxic).
- Emulsion breakers are about 10 ppm (toxic).
- Corrosion inhibitors are about 20 to 160 ppm (toxic to moderately toxic).

3.4.4.2 Oil Spills

Oil spills have occurred in Cook Inlet, and these spills and the risk of future spills are an issue of major concern. The oil spill records are not complete for the entire production period of Cook Inlet (1957 to present); however, this section summarizes the available information about the nature of oil spills from production facilities and pipelines in Cook Inlet.

There were an average of 600 spills per year in the Cook Inlet area between 1996 and 2002, with an average of 71,480 gallons released per year. The area also averages six spills greater than 1,000 gallons per year. This includes spills from transportation (pipeline, truck, rail, and air), vessels (tanker, fishing, and other), storage facilities (tank farms), and other facilities. Transportation and storage facilities accounted for 41 percent and 39 percent of the total spills, respectively, although spills from transportation facilities accounted for 73 percent of the total volume released (ADEC 2003).

Most TEK interviewees were aware of the platforms and expressed concern about the threat of a major accident such as a spill or blowout. The fear of blowouts stems in part from interviewees' experiences during the 1989 Exxon Valdez oil [tanker] spill and in part from lack of information about what preventive measures are in place on the platforms.

The Exxon Valdez oil spill had a big impact on the area and the people. Specifically, fish health suffered, as many fish displayed sores and other signs of harm. This experience has increased local concern about potential impacts from Upper Cook Inlet oil and gas activities. Interviewees stated that the Exxon Valdez oil spill had impacts both on the local environment and on the social structure of communities. According to interviewees, prior to the oil spill people harvested subsistence foods with hardly any worries with the exception of red tides and tribal members had previously been very traditional in social practices, such as subsistence production and sharing.

The injection of a cash and a wage economy during the Exxon Valdez oil spill clean-up led to major shifts, and people (employed by Exxon clean-up activities) were temporarily distracted by what had occurred because of big payoffs, as high wages were paid. Some communities experienced a greater dependence on cash and greater reliance on food purchased from stores after the oil spill. Interviewees indicated that this shift was exacerbated by concerns over whether local resources were safe to eat following the oil spill. Interviewees noted that changes such as the decline in shellfish occurred before the Exxon Valdez oil spill and were exacerbated by the spill. Several interviewees indicated that marine life is beginning to recover from the effects of the spill.

Interviewees are also concerned about the consequences of a potential spill, caused by an accident on the platforms. For example, they wanted to know if there is scientific data on the effects of a recent oil spill near Kodiak on water and animal life in that area. Another interviewee expressed concern about the effects of an oil spill from the platforms should an event occur such as the eruption of Mount Spurr. This concern is also based on knowledge of oil industry blow-outs and spills. Other interviewees described experiencing an accident in Cook Inlet, prior to the Exxon Valdez oil spill. In 1986, oil was spilled into Cook Inlet and commercial set-net fishermen explained that they were unable to sell fish for the following year.

Some interviewees suggested establishing spill response teams in the villages [using oil company funding] to address concerns about the threat of a potential oil spill from the platforms.

Three pipeline ruptures in 1966, 1967, and 1968 each released approximately 1,400 barrels of oil to Cook Inlet (MMS 2003). Crude- and refined-oil spills from tankers, motor vessels, or other known sources have also occurred in Cook Inlet. The oil spill records are not complete for the entire period of Cook Inlet recorded marine transportation spills (1949 to present); however, the available information is summarized below:

Table 3-9. Available Marine Oil Spill Information for Cook Inlet

Year	Name	Location	Type	Barrels
1966	Tanker vessel	Nikiski	Diesel	2,000
1966	Tanker vessel	Nikiski	Dock oil	1,000
1967	*Washington Trader*	Drift River	Terminal crude oil	1,700
1976	*Sealift Pacific*	Nikiski	JP-4	9,420
1984	*Cepheus*	Near Anchorage	Jet A	4,286
1987	*Glacier Bay*	Near Kenai	Crude oil	3,095
1989	*Lorna B*	Nikiski	Diesel	1,547–1,714

In addition to the tanker spills, there are at least two documented spills from outside the Cook Inlet area that have drifted into Cook Inlet. The first spill was from an unidentified source documented in 1970. The suspected source of the spill was from some tank vessel dumping ballast and slop at sea, which used to be a common practice. No oil-spill volume was provided in the spill report. From the estimated number of dead birds and the length of coastline oiled, it was estimated that this spill was greater than or equal to 1,000 barrels. This spill affected lower Cook Inlet, including the Barren Islands, Kodiak Island, and Shelikof Strait. The second documented tanker spill is the *Exxon Valdez* spill, which drifted into lower Cook Inlet. It is estimated that approximately 1 to 2 percent of the spill entered lower Cook Inlet, reaching as far north as Anchor Point (MMS 2003).

No oil spills due to blowouts were identified in the spill record. However, three natural gas blowouts occurred in Cook Inlet:

- The Pan American blowout occurred during drilling on August 1962 from the Cook Inlet State No. 1 well. The well encountered natural gas and blew gas from August 23, 1962, to October 23, 1963.

- A short-term natural gas blowout occurred at the Grayling Platform in May 1985. Union Oil Company was drilling well G-10RD in the McArthur River Field when the blowout occurred. The event lasted from May 23 to May 26.

- The last blowout in Cook Inlet occurred at the Steelhead Platform from well M-26 on December 20, 1987. Marathon Oil Company was drilling into the McArthur River Field. The gas blowout lasted from December 20, 1987, until December 28, 1987 (MMS 2003).

The reported amount of oil spilled in Cook Inlet waters from 1965 through 1975 was 20,636 barrels; between 1976 and the end of 1979, an additional 9,534 barrels were reported spilled. Of the total hydrocarbons spilled between 1965 and 1979, the aforementioned large spills (equal to or greater than 1,000 barrels) can account for 17,920 barrels out of 30,170, or 59 percent of the total spillage (MMS 2003).

The spill rate for the offshore oil and gas production industry in Cook Inlet is approximately 2,700 small spills (less than 1,000 barrels) per billion barrels. It is estimated that one small pipeline spill per month in the Cook Inlet watershed, onshore and offshore, occurred from 1997 through 2001 (MMS 2003).

The overall pipeline spill rate for Cook Inlet, including onshore and offshore oil and gas pipelines, decreased from 1.1 releases per month in 1997–2001 to 0.5 releases per month in 2002–2005. This positive trend can be attributed to the decrease in onshore oil processing releases; offshore oil spills remained unchanged at a rate of approximately 1 release per year, and natural gas pipeline spills rose from 0.8 per year to 3 per year (Cook Inlet Keeper 2005).

The oil industry is not the only or necessarily the primary spiller in Cook Inlet. In the state of Alaska, 269 nonpetroleum-industry oil spills have been reported; the reported amount of oil spilled in 206 of the spills was 22,746 barrels, and no volume was reported for 63 spills. (Nonpetroleum-industry spills included spills from fishing boats, vessels carrying refined products to communities, and other vessels.) Nontank vessels and other unregulated operators had 10 times higher occurrence rates and 50time higher volume spillage than oil industry and other regulated operators in Alaskan waters. This spillage includes sinking of nontank vessels such as tugboats and fishing vessels (MMS 2003). Oily ballast water discharges have occurred and are still occurring in the Gulf of Alaska, including Cook Inlet. Recently, Alaska had to take significant enforcement actions against cargo and cruise ships operating in the Gulf of Alaska for deliberately and illegally discharging oily waste (MMS 2003).

3.5 BIOLOGICAL RESOURCES

3.5.1 Lower Trophic Level Organisms

This section discusses the lower trophic level organisms found in the planktonic, benthic, and intertidal habitats of Cook Inlet. Lower trophic level organisms are categorized as planktonic (floating or drifting in the water column), and benthic (living on the seafloor or in sediments). Generally, the lower Cook Inlet intertidal and subtidal habitats are considered to be very environmentally sensitive because of their concentrations of lower trophic level organisms and vulnerability to environmental degradation from oil slicks (MMS 2003).

3.5.1.1 Plankton

Phytoplankton and zooplankton are the major constituents of the planktonic communities that form the base of marine food webs. During the summer, lower Cook Inlet is among the most productive high-latitude shelf areas in the world (SAIC 2002). Phytoplankton productivity in northern Cook Inlet is limited by turbidity, tidal variations, and high sediment loads (SAIC 2002). The silt-laden waters that enter upper Cook Inlet load the inlet with sediment and retard its primary productivity. Marine productivity in lower Cook Inlet decreases in a northerly direction. At a station immediately south of the Forelands, the euphotic zone (the upper limit of effective light penetration for photosynthesis) was extremely shallow, ranging from 1 to 3 meters. The suspended particulate matter limits light penetration, likely limiting the bioavailability of surface nitrate (SAIC 2002).

Zooplankton, a common source of food for fish, shellfish, marine birds, and occasionally marine mammals, feed on phytoplankton. Thus, zooplankton productivity and growth cycles respond positively to phytoplankton productivity. Zooplankton production varies seasonally, with greater abundance in spring and summer, in lower Cook Inlet. Zooplankton are abundant in lower Cook Inlet but are substantially reduced in the upper inlet (SAIC 2002).

3.5.1.2 Benthic Communities

Mollusks, polychaetes, and bryozoans are the dominant infauna of seafloor habitat in Cook Inlet. Over 370 invertebrate taxa have been reported in samples from lower Cook Inlet. Mollusks and bryozoans reside in the muddy bottom substrates, while mollusks dominate the sandy bottom substrates. Mobile deposit-feeding infauna are widely distributed in nearshore environments where deposition rates of fine sediments are high. Infaunal organisms are important trophic links for crabs, flatfishes, and other organisms common in the waters of Cook Inlet (SAIC 2002).

Crustaceans, mollusks, and echinoderms dominate the epifauna of Cook Inlet. The percentage of sessile organisms in Cook Inlet is relatively low inshore and increases toward the continental shelf. Rocky-bottom areas consist of lush kelp beds with low epifaunal diversity, moderate kelp beds with well-developed sedentary and predator/scavenger invertebrates, or little or no kelp with moderately developed predator/scavenger communities and a well-developed sedentary invertebrate community (SAIC 2002). Table 3-10 lists benthic organisms present in upper Cook Inlet.

Table 3-10. Benthic Organisms Present in Upper Cook Inlet

Benthic Organisms Observed on Beaches[a]		Major Species in Offshore Waters[b]
Chlorophyta	**Arthropoda**	**Polychaetes**
Ulothric laetevirens	Amphipoda	*Gylcera tenuis*
Enteromorpha sp.	*Gammarus* sp.	*G. capitata*
E. intestinalis	*B. wilkitzskii*	*Nephtys* sp.
E. compressa	*Anisogammarus* sp.	*N. ciliata*
Ulva lactuca	*A. confervicolus*	*Ophelia limacina*

Table 3-10. Benthic Organisms Present in Upper Cook Inlet (Continued)

Benthic Organisms Observed on Beaches[a]		**Major Species in Offshore Waters[b]**
Coelenterata	*Caprella* sp.	*Polygordius* sp.
Hydrozoa	*Atylus* sp.	*Scolelepis* sp.
Obelia sp.	Cirripedia	*Scoloplos armiger*
Plumularia sp.	*Balanus crenatus*	*Spaerosyllis pirifera*
Thuiaria sp.	*B. balanoides*	*Spiophanes bombyx*
Tubularia larynx	Decapoda	*Streotistkkus br. katuoakoa*
Anthozoa	*Crago* sp.	*S. nr. latipalpa*
Anthopleura sp.	*Cancer* sp.	*Chaetozone setosa*
Ectoprocta	*Cragon franciscorum*	*Eteone ne. longa*
Membranipora sp.	Isopoda	**Amphipods**
Eucratea sp.	*Idotoega entomon*	*Orchomene cf. pacifica*
Scrupocellaria sp.	*Neosphaeroma oregonensis*	*Paraphoxus milleri*
	Saduria entomon	*Photis* sp.
Platyhelminthes	**Arthropoda**	**Mollusks**
Notoplana sp.	*Gnorimosphaeroma oregonensis*	*Astarte* sp.
Brachiopoda	Pycnogonida	*Glycymeris subobsoleta*
Terebratilia sp.	*Pseudopallene* sp.	*Liocyma fluctuosa*
Annelida	**Echinodermata**	*Propebela* sp.
Polychaete Larvae	Asteroidea	*Tellina nucloides*
Mollusca	*Leptasterias* sp.	**Sand Dollars**
Gastropoda	**Chordata**	*Echinarachnius parma*
Anisodoris sp.	Unidentified Cling Fish	
Acmaea sp.		
A. pelta		
Littorina sp.		
Phenacoptygma sp.		
Buccinium sp.		
Buccinium sp. egg cases		
Lamellibranchia		
Tresus sp.		
Macoma sp.		
Yoldia myalis		
Y. limatula		

Notes:

[a] Samples obtained from Salamatof, Nikishka Bay, and Kalifornsky beaches (Rosenberg et al. 1969, as cited in SAIC 2002).

[b] Samples obtained from lower Cook Inlet off Kachemak Bay (Dames and Moore 1978, as cited in SAIC 2002).

3.5.2 Fisheries Resources

Fish

Little published information exists about the fish of upper Cook Inlet. There is more information on the fish in central and lower Cook Inlet because of the importance of commercial fisheries in those areas. It is thought that upper Cook Inlet does not provide a plentiful primary food source or adequate safe habitat given its low phytoplankton productivity and severe tidal currents. Table 3-11 presents a list of fish species that have been documented in central Cook Inlet (SAIC 2002).

Table 3-11. Fish Species Present in the Central Cook Inlet Area

Common Name	Scientific Name
Fresh Water	
Arctic lamprey	*Lampetra japonica*
Burbot	*Lota lota*
Arctic grayling	*Thymallus arcticus*
Threespine stickleback	*Gasterosteus aculeatus*
Anadromous	
Bering cisco	*Coregonus laurettae*
Pink salmon	*Oncorhynchus gorbuscha*
Chum salmon	*Oncorhynchus keta*
Chinook salmon	*Oncorhynchus tshawytscha*
Sockeye salmon	*Oncorhynchus nerka*
Coho salmon	*Oncorhynchus kisutch*
Inconnu	*Stenodus leucichthys*
Dolly Varden	*Salvelinus malma*
White sturgeon	*Acipenser transmontanus*
Marine	
Pacific herring	*Clupea pallasii*
Eulachon	*Thaleichthys pacificus*
Longfin smelt	*Spirinchus thaleichthys*
Surf smelt	*Hypomesus pretiosus*
Pacific cod	*Gadus macrocephalus*
Pacific tomcod	*Microgadus proximus*
Walleye pollock	*Theragra chalcogramma*
Armorhead sculpin	*Gynmocanthus galeatus*
Pacific staghorn sculpin	*Leptocottus armatus*
Sturgeon poacher	*Agonus acipenserinus*
Tubenose poacher	*Pallasina barbata*
Variegated snailfish	*Liparis gibbus*
Masked greenling	*Hexagrammos octogrammus*

Table 3-11. Fish Species Present in the Central Cook Inlet Area (Continued)

Common Name	Scientific Name
Daubed shanny	*Lumpenus maculatus*
Snake prickleback	*Lumpenus sagitta*
Pacific sand lance	*Ammodytes hexapterus*
Arrowtooth flounder	*Atheresthes stomias*
Butter sole	*Pleuronectes Isolepis*
Starry flounder	*Platichthys stellatus*
Yellowfin sole	*Pleuronectes asper*

Source: SAIC (2002).

3.5.2.1 Anadromous Fish

Anadromous fish migrate through northern Cook Inlet toward spawning habitat in rivers and streams, and juveniles travel through Cook Inlet toward marine feeding areas. The Susitna River drainage is a major source of anadromous fish in upper Cook Inlet. Table 3-12 presents the timing of anadromous fish migrations in Cook Inlet (MMS 2003; SAIC 2002).

Table 3-12. Migration Timing of Anadromous Fish Species in Cook Inlet

Species	Timing of Adult In-Migration	Timing of Smolt Out-Migration
Chinook Salmon (*Oncorhynchus tshawytscha*)	Early May–Late July	Mid-June–Late August
Sockeye/Red Salmon (*O. nerka*)	Late June–Early August	Mid-May–Late August
Coho/Silver Salmon (*O. kisutch*)	Late July–November	March–Late September
Pink Salmon (*O. gorbuscha*)	Early July	Early Spring
Chum/Dog Salmon (*O. keta*)	Early July–Early August	Late May–Late June
Eulachon/Hooligan (*Thaleichthys pacificus*)	Early to Mid-May	June
Bering Cisco (*Coregonus laurettae*)	August–October	Late April–May
Dolly Varden Char (*Salvelinus malma*)	Late Summer–Fall	Spring–Fall

Source: SAIC (2002).

Salmonids

The Cook Inlet region is an early-life rearing area and migratory corridor for all five Pacific salmon species—chum salmon, sockeye salmon, coho salmon, Chinook or king salmon, and pink salmon—as well as Dolly Varden and steelhead trout. Run timing and migration routes for all five salmon species overlap. In upper Cook Inlet, adult salmon inhabit marine and estuarine waters from early May to early November (MMS 2003).

Chum salmon (*Oncorhynchus keta*) are the most widely distributed of all Pacific salmonids. Chum salmon grow to an average weight of between 3 and 8 kilograms (7 to18 pounds), but can reach 14 kilograms (31 pounds). They do not remain in fresh water after emergence as do sockeye, coho, and Chinook, but migrate to estuarine areas spending the summer feeding on zooplankton. In the fall they move offshore, where they remain 3 to 5 years. At maturity, usually around 4 years of age, chum return to their natal streams in the late summer and early fall. Most chum salmon spawn in small streams within a few miles of the shore, or within the intertidal zone, but sometimes travel great distances up large rivers. Chum salmon enter the Cook Inlet region beginning in early July, and the spawning runs continue through early August. Chum salmon spawn in many streams throughout the region and deposit their eggs in stream gravels. Fry subsequently move downstream to the ocean, where they remain for three to four winters before returning to natal streams to spawn and die (MMS 2003).

Sockeye salmon (*O. nerka*) spawn in stream systems with lakes. The fry spend up to 4 years in fresh water lakes before migrating to sea in the spring, where they spend 1 to 4 years feeding on zooplankton and small fish. Most sockeye spend two to three winters in the North Pacific Ocean before returning to natal streams to spawn in late June through August. Spawning occurs in streams and rivers and along lake beaches. Sockeye salmon are an important commercial and subsistence salmon species in Cook Inlet. Adult sockeye return to Cook Inlet and the Shelikof Strait region annually in late June, and runs continue through early August (MMS 2003).

Coho salmon (*O. kisutch*) are found in coastal waters of Alaska from Southeast to Point Hope on the Chukchi Sea and in the Yukon River to the Alaska-Yukon border. They are the last salmon species to return to the proposed lease-sale area. Coho salmon return to spawn in natal stream gravels from July to November, usually the last of the five salmon species. Fry emerge in May or June and live in ponds, lakes, and stream pools, feeding on drifting insects. Coho salmon can reside in fresh water up to three winters before migrating to sea where they typically remain between 6 months to two winters before returning to spawn in late summer or early fall (MMS 2003).

Chinook salmon (*O. tshawytscha*), the largest of all Pacific salmonids, are the first of the five species to return each season in approximately mid-May (ADFG 1986). Soon after hatching, most juvenile Chinook salmon migrate to sea, but some remain for a year in fresh water. Most Chinook salmon return to natal streams to spawn in their fourth or fifth year. The Susitna River supports the largest Chinook salmon run in upper Cook Inlet, which includes systems below the Forelands to the latitude of N 59° 46' 12", near Anchor Point (ADFG 1986).

Pink salmon (*O. gorbuscha*), also known as “humpback” or “humpy” because of the pronounced, laterally flattened hump that develops on the backs of adult males before spawning, are the smallest salmon species in Cook Inlet. They average between 1 and 2 kilograms (3 to 4 pounds). Pink salmon enter their spawning streams between June and mid-October and typically spawn within a few miles of the coast, within the intertidal zone, or at the mouths of streams. The eggs hatch during winter, and in spring, the young emerge from the gravel to migrate downstream to salt water. Pink salmon stay close to the shore moving along beaches during their first summer feeding on plankton, insects, and young fish. At about 1 year of age, pink salmon move offshore to ocean feeding grounds in the Gulf of Alaska and Aleutian Islands. Usually pink salmon migrate back to fresh water during their second summer (MMS 2003).

Dolly Varden (*Salvelinus malma*) are abundant in all coastal Alaska waters. They may be anadromous or reside entirely in fresh water. Nonresident Dolly Varden cycle seasonally between fresh water and marine environments. In Cook Inlet, Dolly Varden spawn annually in rivers during the fall; hatching occurs in March. They overwinter in fresh water drainages, and then disperse into coastal waters. Juvenile Dolly Varden migrate to sea after the third or fourth year, usually in May or June. At age 5 or 6 years (sometimes 5 to 9 years) mature Dolly Varden return to their natal streams to spawn. Some Dolly Varden live to spawn two to three times during their lifetime (MMS 2003).

Steelhead trout (*O. mykiss*) are rainbow trout that spend part of their lives at sea. Some steelhead return to natal streams in July and are known as “summer steelhead.” Fall-run steelhead, more common in Alaska, return from August through October, and into winter. Steelhead spawn from mid-April through early June. Unlike salmon, steelhead can spawn more than once, returning to sea after spawning. Juvenile steelhead remain in the parent stream for 3 years before migrating to sea (ADFG 2004b).

Cutthroat trout (*O. clarki*) occur as sea-run or resident (non-sea-run) forms in streams and lakes along the coastal range from lower southeast Alaska to Prince William Sound and are the most common trout species in the region (http://www.state.ak.us/adfg/notebook/fish). The resident form lives in a wide variety of biotopes from small headwater tributaries and bog ponds to large lakes and rivers. Sea-run cutthroat usually are found in river or stream systems with accessible lakes, mostly south of Fredrick Sound. In some watersheds, such as the Taku River, the two forms are found together. The extent of breeding between the two forms is unknown, and the reason that some fish migrate to sea while others stay in fresh water remains unknown (MMS 2003).

Resident and sea-run coastal cutthroat trout have similar early life histories. Adults spawn in small, isolated headwater streams from late April to early June, and young cutthroat emerge from the gravel in July. Later, the young occupy beaver ponds, sloughs, or lakes. Sea-run juveniles can be displaced to downstream mainstem and estuarine areas where they reside for the summer, then migrate back upstream with the onset of winter floods. Sea-run cutthroat rear for 3 to 4 years in fresh water and migrate to sea during May, when they are about 20 centimeters (8 inches) long. Time at sea varies from a few days to more than a hundred days before they return to their natal stream. In autumn, they return to their natal stream where they mature during the winter months. Resident coastal cutthroat remain in fresh water after emergence and live in streams, beaver ponds, sloughs, and lakes (MMS 2003).

Other Anadromous Fish

White sturgeon (*Acipenser transmontanus)* are anadromous fish found in northern Cook Inlet. Most of their nearshore life is spent in water depths of 30 meters or less. Although little is known about white sturgeon migrations in salt water, one tagged specimen was caught 1,056 kilometers from where it was tagged (MMS 2003). In the spring, mature white sturgeon enter the estuaries and lower reaches of river systems. They spawn over rocky bottoms in swift water where the sticky eggs adhere to the river bottom. The amount of time needed for the eggs to hatch is not known. After spawning, the adults return to sea (MMS 2003).

Bering cisco (*Coregonus laurettae*) have been reported in the Susitna River drainage, entering the river system in late summer. Egg incubation occurs over winter and larvae move into northern Cook Inlet after ice-out in the spring from late April to May (SAIC 2002).

3.5.2.2 Pelagic Fish

Pelagic fish inhabit water layers above the abyssal zone (waters below 4,000 meters) and beyond the nearshore zone between high- and low-water marks). They may migrate long distances in response to changing environmental conditions, or for reproduction or food. Some pelagic fish segregate by cohort or life-history stage and use different habitat areas during these different life stages. For example, while some adults may enter Cook Inlet during a year (for example, 2004) to spawn after spending years at sea in the North Pacific Ocean, other members of the same population continue to reside at sea and may not enter Cook Inlet for a year or more (MMS 2003).

Eulachon/candlefish/hooligan *(Thaleichthys pacificus)*, a small anadromous forage fish (up to 23 centimeters long), is found throughout Cook Inlet. Mature eulachon, typically 3 years old, spawn in May soon after ice-out in the lower reaches of streams and rivers. The Susitna River supports a run of eulachon estimated to be in the millions (SAIC 2002). As juveniles and adults, they feed primarily on copepods and plankton. As the spawning season approaches, eulachon gather in large schools at stream and river mouths, with upstream migration tied to stream water temperature. Most eulachon die after spawning. Eulachon is an important food-chain prey species for other fish, birds, and marine mammals (ADFG 2004c). The Cook Inlet population also supports small dipnet fisheries in upper Cook Inlet (SAIC 2002).

Pacific herring *(Clupea pallasii)* is a comparatively small fish occurring in large schools in the Cook Inlet region in early April and possibly through early fall. The Pacific herring is one of more than 180 species in the herring family *Clupeidae*. Herring are important prey for a wide variety of fishes, mammals, and birds. Pacific herring migrate in schools and are found along both shores of the North Pacific Ocean, ranging from San Diego Bay to the Bering Sea and Japan. These fish may grow to 46 centimeters (18 inches) in length, but a 23-centimeter (9-inch) specimen is considered large (MMS 2003).

Herring spawn after reaching maturity at 3 to 4 years of age, and continue to spawn annually in shallow vegetated areas of intertidal and subtidal zones. Herring spawn extensively in Cook Inlet along the South Alaska Peninsula, and the Shelikof coastline of Kodiak Island. Kamishak Bay is one major spawning area that supports a short-season sac-roe fishery (MMS 2003).

Pacific sand lance *(Ammodytes hexapterus)* occur throughout coastal marine waters of Alaska. Sand lance are a quintessential forage fish, and as a group (there are six species worldwide) they are possibly the single most important taxon of forage fish in the Northern Hemisphere. Sand lance are preyed on by numerous species of seabird, marine mammal, and fish, in addition to various land birds and animals. Population fluctuations and distribution of predators are frequently linked to sand lance abundance. Sand lance also play an important role in the ecosystem as consumers of zooplankton.

The Pacific sand lance is an important forage fish of 20 centimeters (8 inches) in length and are abundant in shallow waters to depths of 100 meters (330 feet). Upon maturity (2 years), Pacific sand lance spawn within bays and estuaries, on fine gravel and sandy beaches, typically between late September and October after summer water temperatures begin to decline. Sand lance approach intertidal sites where spawning sometimes has taken place for decades. Spawning occurs in dense formations. Female sand lance burrow through the substrate while releasing eggs, which results in the formation of scour pits in intertidal sediments. Larvae hatch at a size of approximately 5 millimeters (less than 1 inch) before the spring plankton bloom (MMS 2003).

Capelin (*Mallotus villosus* [Muller]) is a major forage fish of the Cook Inlet region. A small fish (mature specimens are generally 13–20 centimeters [5–8 inches] long), the capelin is classified within the family *Osmeridae* (along with smelts). Populations of capelin are large and range extensively over Alaskan waters, generally inhabiting pelagic waters. Capelin are mainly filter feeders, thriving on planktonic organisms such as euphausiids and copepods (MMS 2003).

Capelin spawn on beaches and in deeper waters and are highly specific regarding spawning conditions. Temperature, tide, and light conditions are primary criteria for successful spawning; most spawning takes place at night or in dull, cloudy weather. On the Pacific coast of Canada, capelin spawn on gravelly beaches in various localities in the Strait of Georgia during late September or October. Capelin also spawn in the southwestern Bering Sea in May, and spawning capelin have been harvested from Bristol Bay at about the same time. Capelin eggs attach to beach and bottom gravels. Depending on temperature, hatching ranges from 15 to 55 days. Most capelin die after spawning. Currently, capelin have no economic value to Alaska; however, the species is used extensively for food by other fishes, marine mammals, and seabirds (MMS 2003).

3.5.2.3 Groundfish

Groundfish are finfishes that remain on the seafloor for much of the time. However, during spawning and early life, these fish may be in pelagic waters. The following groundfish are commercially valuable in the Cook Inlet, Kodiak, and South Aleutian Peninsula regions.

Pacific cod *(Gadus macrocephalus),* largely demersal (bottom-dwelling) fish that may reach a length of 1 meter (3.25 feet), are distributed over lower Cook Inlet. They are fast-growing and mature in approximately 3 years. Spawning season occurs from January through May. Currently, there is rapid turnover of subpopulations due to predation and commercial fishing pressure (MMS 2003).

Pacific hake (Pacific whiting) (*Merluccius productus*), a codlike fish, can be found throughout the Cook Inlet region although not in large numbers. Approximately about 90 centimeters (36 inches) in length, its principal identifying characteristic is the presence of two dorsal fins. Hake spawn for an extended annual period, possibly for up to several months in this region. Depending on the size of the fish, hake may release nearly a half-million eggs per individual, and the pelagic eggs may hatch in as little as 3 days. Hake are demersal in nature, although they sometimes make vertical ventures into the water column at night, probably for feeding. Larval hake consume copepods and similarly sized organisms. Adult hake prey on euphausiids, sand lance, anchovies, and other forage fishes. In turn, hake are prey for other marine fishes, marine birds, and marine mammals (MMS 2003).

The Pacific halibut *(Hippoglossus stenolepis)* is a large flatfish that occurs throughout Cook Inlet at depths of 50–500 meters. Halibut spawn during the winter along the edge of the continental shelf at water depths of 365–550 meters (200–300 fathoms). Significant spawning sites in the vicinity of lower Cook Inlet are Portlock Bank, northeast of Kodiak Island, and Chirikof Island, south of Kodiak Island (IPHC 1998). Larvae 3 to 5 months old drift in the upper 100 meters of water; winds push them to the shallow sections of the continental shelf, where they spend next 5–7 years. Juvenile halibut migrate seasonally in a clockwise direction from deeper water in the winter to shallow water in summer (ADFG 2004f).

Sablefish *(Anoplopama fimbria)*, also known as black cod, is found within the Cook Inlet proposed lease-sale area and is a valued commercial species. However, most are harvested outside the lease-sale area because this species usually occurs at depths of 365–915 meters. Sablefish are largely demersal with some nocturnal forays into pelagic waters. Sablefish grow to 1 meter (40 inches) in length and are a relatively long-lived species (some to 35 years). Sablefish probably spawn during the spring, but little is known about their spawning movements or egg-larval development. The eggs are pelagic, as are the early prolarvae. Later larval stages occupy waters 150 meters deep. Sablefish feed indiscriminately on a large variety of benthic and pelagic fauna (MMS 2003).

Walleye pollock *(Theragra chalcogramma)*, a codlike species, occurs throughout the proposed lease-sale area, with a large spring spawning aggregation in parts of Shelikof Strait. Pollock are found at depths of 20–2,000 meters. The species also inhabits pelagic waters in some areas at various times. Walleye pollock range to 91 centimeters (36 inches) long; however, they enter the commercial-trawl fisheries at about 25 centimeters (12 inches) long. Adult pollock consume shrimp, sand lance, herring, small salmon, and similar organisms they encounter. Walleye pollock also are cannibalistic (MMS 2003).

Walleye pollock spawn in the spring in large aggregations, although there is extended spawning by smaller numbers throughout the year. Eggs may be close to the surface initially and hatch in about 10–20 days (depending on water temperatures). Pelagic larvae remain at the sea surface for up to 30 days, again depending on water temperature (and available food supply) (MMS 2003).

Other groundfish, such as arrowtooth flounder, yellowfin sole, and Atka mackerel, inhabit the Cook Inlet, Kodiak, and South Aleutian Peninsula region in lesser numbers. These species generally are in the same habitats as the groundfish species discussed above.

3.5.2.4 Shellfish

"Shellfish" is a collective term that generally refers to harvestable mollusks and crustaceans. The coastal ecosystem of the Gulf of Alaska underwent a shift from an epibenthic community dominated largely by crustaceans to one now dominated by several species of finfishes. The reorganization of domineering species in coastal waters resulted from a shift in ocean climate during the late 1970s (MMS 2003).

Razor clams *(Siliqua patula)* are bivalve mollusks harvested throughout their range by commercial and sport fisheries. The two most common species of razor clam are the Pacific *(S. patula)* and the northern or Arctic razor calm (*S. alta)*. The Arctic razor clam is found in southern Cook Inlet and westward to the Bering Sea and Siberia. The Pacific razor clam is more widely distributed and can be found from southern California to the Aleutian Islands. Razor clams inhabit surf-swept and somewhat protected beaches of the open ocean, from 1.2 meters (4 feet) above mean low-water level to depths of 55 meters (180 feet). Large assemblages of razor clams occur in western Cook Inlet near Augustine Island and in Kachemak Bay (MMS 2003).

Pacific weathervane scallop *(Patinopecten caurinus)* is one of several species of true scallops found in the eastern North Pacific Ocean. This scallop supports a sporadic but important commercial fishery in Alaska waters from Yakutat to the eastern Aleutians (MMS 2003).

Weathervane scallops have specialized adaptations that facilitate escaping predation or other disturbing conditions. Scallops are the only bivalves whose adult stage is capable of swimming. This ability is accomplished by the rapid ejection of water from the interior of the shell in a jet-like action. Swimming can be maintained for 15–20 seconds and rarely exceeds 6 meters (20 feet). Another unique adaptation of scallops is the presence of many jewel-like eyes that are sensitive to changing light or moving objects. Also, scallops have small tentacles that are highly sensitive to waterborne chemicals and water temperature (MMS 2003).

Weathervane scallops are found on sand, gravel, and rock bottoms from 45 to 180 meters (150 to 600 feet). In Cook Inlet, there are two scallop beds east of Augustine Island in 38–115 meters (120–360 feet) that are commercially harvested. Weathervane scallops feed by filtering microscopic plankton from the water (MMS 2003).

Pandalid shrimp. Five species of pandalid shrimp of various commercial and subsistence values are found in the cool waters off the coast of Alaska (http://www.state.ak.us/adfg/notebook/shellfish/shrimp.htm). **Pink shrimp** (*Pandalus borealis*) are the foundation of the commercial trawl shrimp fishery in Alaska. Pinks are circumpolar in distribution, though the greatest concentrations occur in the Gulf of Alaska. The **humpy shrimp** (*P. goniurus*), ranging from Puget Sound to the arctic coast of Alaska, is usually harvested incidentally to pink shrimp. In some cases, however, the humpy constitutes the primary species caught. The **sidestripe shrimp** (*Pandalopsis dispar*) is also caught incidentally to pinks; however, there are small trawl fisheries in Prince William Sound and southeast Alaska that target this deeper water species. The

coonstripe shrimp (*Pandalus hypsinotis*) is the prized target of various pot shrimp fisheries around the state. Coonstripe shrimp can be found from the Bering Sea to the Strait of Juan de Fuca, while sidestripes range from the Bering Sea to Oregon. **Spot shrimp** (*P. platyceros*) is the largest shrimp in the North Pacific. Ranging from Unalaska Island to San Diego, this species is highly valued by commercial pot fishers and subsistence fishers alike. Most of the catch from the sidestripe, coonstripe, and spot fisheries is sold fresh in both local and foreign markets (MMS 2003).

Shrimp inhabit varying depths and habitat types. Spots and coonstripes generally are associated with rock piles, coral, and debris-covered bottoms; whereas pinks, sidestripes, and humpies typically occur over muddy bottom. Pink shrimp occur over the widest depth range (18–1,460 meters, or 10–800 fathoms); humpies and coonstripes usually inhabit shallower waters (5–365 meters, or 3–200 fathoms). Spot shrimp seem to be caught in greatest concentrations around 110 meters (60 fathoms) but range from 4–460 meters (2–250 fathoms). Sidestripes typically are found from 46 to 640 meters (25 to 350 fathoms), but most concentrations occur in waters deeper than 73 meters (40 fathoms) (MMS 2003).

Most shrimp migrate seasonally from deep to shallow waters in addition to exhibiting diel migrations vertically within the water column. Pink shrimp, for example, have been observed moving off the bottom in the evening, occupying the whole water column for much of the night and returning to the bottom in early morning. Pandalid shrimp are opportunistic bottom feeders that will eat a wide variety of items such as worms, diatoms, detritus (dead organic matter), algae, and various invertebrates. Shrimp themselves often are the diet of large predator fish such as Pacific cod, walleye pollock, flounders, and salmon (MMS 2003).

Alaskan king crab. Three commercial king crab species are found in Alaska. **Red king crabs** (*Paralithodes camtschaticus*) have been the commercial “king” of Alaska’s crabs. It occurs from British Columbia to Japan; Bristol Bay and the Kodiak Archipelago are the centers of its abundance in Alaska. **Blue king crabs** *(P. platypus*) live from southeastern Alaska to Japan; the Pribilof Islands and St. Matthew Island are their areas of highest abundance in Alaska. **Golden king crabs** (*Lithodes aequispinus*) are distributed from British Columbia to Japan; the Aleutian Islands are their Alaskan stronghold of abundance. Red and blue king crabs can occur from the intertidal zone to about 180 meters (100 fathoms) or more. Golden king crabs live mostly between 180 and 730 meters (100 and 400 fathoms) but can occur from 90 to 915 meters (50 to 500 fathoms) (MMS 2003).

Adult red and blue king crabs exhibit nearshore to offshore (or shallow to deep) annual migrations. They move to shallow water in late winter, and by spring the female’s embryos hatch. Adult females and some adult males molt and mate before they return to offshore feeding areas in deeper waters. Adult crabs tend to segregate by sex off the mating-molting grounds. Red, blue, and golden king crabs are seldom found coexisting with one another, even though the depth ranges they live in and habitat areas may overlap. Adult male red king crabs have been known to migrate up to 160 kilometers (100 miles) round-trip annually, moving at times as fast as 1.6 kilometers (1 mile) per day. Less is known of the migration of golden king crabs, but it is believed they migrate rather vertically, because they generally inhabit steepsided ocean bottoms (MMS 2003).

King crabs are known to eat a wide assortment of marine life, including worms, clams, mussels, snails, brittle stars, sea stars, sea urchins, sand dollars, barnacles, crabs and other crustaceans, fish parts, sponges, and algae. King crabs are consumed by a wide variety of predators, including fishes (Pacific cod, sculpin, halibut, yellowfin sole); octopuses; king crabs (they can be cannibalistic); sea otters; and several species of nemertean worms, which have been found to eat king crab embryos (MMS 2003).

Dungeness crab *(Cancer magister)* inhabit bays, estuaries, and nearshore waters from Cook Inlet and Prince William Sound, south to Mexico. They are widely distributed subtidally, preferring sandy or muddy sea bottoms or estuarine environments. Generally, Dungeness inhabit shallow water less than 27 meters (15 fathoms), but may be found in depths of 183 meters (100 fathoms). This crab supports both a commercial fishery and a personal-use fishery in Alaska (MMS 2003).

Dungeness crabs scavenge along the seafloor for organisms that live partly or completely buried in the sand. They are predators, and will consume shrimp, mussels, small crabs, clams, and worms (MMS 2003).

Tanner crabs (*Chionoecetes bairdi* and *C. opilio*) are two of the four species of the genus *Chionoecetes* occurring in the eastern North Pacific Ocean and Bering Sea (http://www.state.ak.us/adfg/notebook/shellfish/tanner.htm). They form the basis of a thriving domestic fishery from southeastern Alaska north through the Bering Sea. These crabs also are marketed under their trade names: snow crab (*C. opilio*) and tanner crab (*C. bairdi*) (MMS 2003).

Tanner crabs feed on assorted worms, clams, mussels, snails, crabs and other crustaceans, and fish parts. They are consumed by groundfish, pelagic fish, and humans. Migration patterns are poorly understood; however, it is known that the sexes are isolated during much of the year and cohabit areas during mating season (MMS 2003).

3.5.3 Essential Fish Habitat

The 1996 amendments to the Magnuson-Stevens Act (MSA) PL-104-267, which regulates fishing in U.S. waters, included substantial new provisions to protect important habitat for all federally managed species of marine and anadromous fish. The amendments created a new requirement to describe and identify "essential fish habitat" (EFH) in each fishery management plan. EFH is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, growth to maturity." Federal agencies are required to consult with the National Marine Fisheries Service (NMFS) on all actions undertaken by the agency that may adversely affect EFH (SAIC 2002).

Fishery management plans must identify habitat areas of particular concern (HPC) within EFH. HPCs include living substrates in shallow water that provide food and rearing habitat for juvenile fish, and spawning grounds that might be affected by shore-based activities. Estuarine and nearshore habitats of Pacific salmon (e.g., eelgrass [*Zostera* sp.] beds) and herring spawning grounds (e.g., rockweed [*Fucus* sp.] and eelgrass) are HPCs that can be found in Cook Inlet. Offshore HPCs include areas with substrates that serve as cover for organisms including groundfish. Areas of deepwater coral are also considered HPC, but populations are concentrated off southeast Alaska, out of the proposed project area. All anadromous streams qualify as HPC (SAIC 2002).

An EFH assessment has been prepared as an addendum to the Biological Evaluation that has been prepared for the NPDES permitting process.

3.5.4 Other Nonendangered Fish and Invertebrate Species Found in Cook Inlet

Other nonendangered fish and invertebrate species found in Cook Inlet include those listed below.

- Pacific Ocean perch
- Alaska king crab
- Rock sole
- Alaska plaice
- Rex sole
- Dover sole
- Flathead sole
- Shortraker rockfish
- Rougheye rockfish
- Northern rockfish
- Thornyhead rockfish
- Yellowhead rockfish
- Dusky rockfish
- Sculpins
- Skates
- Squid

3.5.5 Marine and Coastal Birds

The marine and coastal bird community of Cook Inlet and the Gulf of Alaska is both diverse and complex. Three major groups are represented: seabirds (Table 3-13), which make their living primarily on the open ocean; waterfowl (ducks and geese) (Table 3-14), which inhabit a variety of fresh water and nearshore marine habitats; and shorebirds (Table 3-15), which feed mainly on marine and fresh water shorelines. More than 100 species may occur in this area, including 39 seabird species; 35 loon, grebe, and waterfowl species; and 28 shorebird species. Many of these species are afforded protection under the Migratory Bird Treaty Act of 1918, which prohibits the take; possession; import; export; transport; selling; purchase; barter; or offering for sale, purchase, or barter of any migratory bird and eggs, parts, and nests, except as authorized under a valid permit (50 CFR 21.11). Threatened and endangered birds, which are protected under the Endangered Species Act, are discussed in Section 3.6 below. General descriptions of the distribution, abundance, and biology of marine and coastal birds that occur in the Cook Inlet and the Gulf of Alaska are found in the Cook Inlet Planning Area Oil and Gas Lease Sale 149 Final Environmental Impact Statement (EIS) (MMS 1995), the Gulf of Alaska/Cook Inlet Sale 88 Final EIS (MMS 1984), and the Lower Cook Inlet-Shelikof Strait Sale 60 Final EIS (BLM 1981).

Breeding seabirds are an important component of the Cook Inlet bird population. More seabirds breed in the Inlet than throughout the entire northeastern Gulf of Alaska. The most abundant breeding seabirds are fork-tailed storm petrels, tufted puffins, black-legged kittiwakes, common murres, horned puffins, and glaucous-winged gulls (MMS 2003).

Table 3-13. Seabird Species Occurring in the Cook Inlet Area

Common Name	Scientific Name	ESA Status[a]	Occurrence[b]
Short-tailed albatross	*Diomedea albatrus*	E	Acc
Northern fulmar	*Fulmarus glacialis*	--	C/S,M; R/W
Sooty shearwater	*Puffinus griseus*	--	C/S,M
Short-tailed shearwater	*Puffinus tenuirostris*	--	U/S,M
Fork-tailed storm petrel	*Oceanodroma furcata*	--	C/M
Leach's storm petrel	*Oceanodroma leucorboa*	--	U/S
Double-crested cormorant	*Phalacrocorax auritus*	--	C/B,M; U/W
Pelagic cormorant	*Phalacrocorax pelagicus*	--	C/B,M,W
Red-faced cormorant	*Phalacrocorax urile*	--	U/B,M,W
Bonaparte's gull	*Larus philadelphia*	--	C/B,M
Mew gull	*Larus canus*	--	C/B,M,W
Herring gull	*Larus argentatus*	--	C/M; R/S,W
Glaucous-winged gull	*Larus glaucescens*	--	C/B,M,W
Glaucous gull	*Larus hyperboreus*	--	R/S,W,M
Black-legged kittiwake	*Rissa tridactyla*	--	C/B,M; U/W
Sabine's gull	*Xema sabini*	--	U/M; R/S
Arctic tern	*Sterna paradisaea*	--	C/B,M
Aleutian tern	*Sterna aleutica*	--	U/B,M
Common murre	*Uria aalge*	--	U/B,M,W
Pigeon guillemot	*Cepphus columba*	--	C/B,M,W
Marbled murrelet	*Brachyramphus marmoratus*	--	C/M,W
Kittlitz's murrelet	*Brachyramphus brevirostris*	--	C/S; U/W
Ancient murrelet	*Synthliboramphus antiquus*	--	U/S,M,W
Parakeet auklet	*Cyclorrhynchus psittacula*	--	R/B,M
Rhinoceros auklet	*Cerorhinca monocerata*	--	R/S,M
Tufted puffin	*Fratercula cirrhata*	--	C/B,M; R/W
Horned puffin	*Fratercula corniculata*	--	U/B,M; R/W

Source: SAIC (2002).

[a] Federal status under the Endangered Species Act of 1973. E = Endangered.
[b] Abbreviations: Acc = Accidental, B = Breeding Bird, C = Common, M = Migration, R = Rare, S = Summer, U = Uncommon, and W = Winter.

Table 3-14. Waterfowl Species Occurring in the Cook Inlet Area

Common Name	Scientific Name	ESA Status[a]	Occurrence[b]
Common loon	*Gavia immer*	--	U/B,W; C/M
Pacific loon	*Gavia pacifica*	--	U/B; C/M,W
Red-throated loon	*Gavia stellata*	--	C/B,M; U,W
Yellow-billed loon	*Gavia adamsii*	--	U/M; U/W
Red-necked grebe	*Podiceps grisegena*	--	U/W
Horned grebe	*Podiceps auritus*	--	U/W
Tundra swan	*Cygnus columbianus*	--	C/M
Trumpeter swan	*Cygnus buccinator*	--	C/B,M
Greater white-fronted goose	*Anser albifrons*	--	C/B,M
Snow goose	*Chen caerulescens*	--	C/M
Emperor goose	*Chen canagica*	--	U/M,W
Brant	*Branta bernicla*	--	U/M
Canada goose	*Branta canadensis*	--	C/B,M
Green-winged teal	*Anas crecca*	--	C/B,M
Mallard	*Anas platyrhynchos*	--	C/B,M
Northern pintail	*Anas acuta*	--	C/B,M
Northern shoveler	*Anas spatula*	--	C/B,M
Gadwall	*Anas strepera*	--	U/B
American wigeon	*Anas americana*	--	C/B,M
Canvasback	*Aythya valisineria*	--	U/B,M
Ring-necked duck	*Aythya collaris*	--	R/B,M
Greater scaup	*Aythya marila*	--	C/B,M
Lesser scaup	*Aythya affinis*	--	R/B,M,W
Common eider	*Somateria mollissima*	--	U/B,M,W
King eider	*Somateria spectabilis*	--	U/M,W
Steller’s eider	*Polysticta stelleri*	T	U-C/W
Harlequin duck	*Histrionicus histrionicus*	--	C/B,M
Oldsquaw	*Clangula hyemalis*	--	C/M,W
Black scoter	*Melanitta nigra*	–	C/M,W
Surf scoter	*Melanitta perspicillata*	--	C/M,W
White-winged scoter	*Melanitta fusca*	--	C/B,M,W
Common goldeneye	*Bucephala clangula*	--	R/B; C/M,W
Barrow’s goldeneye	*Bucephala islandica*	--	C/B,M,W
Bufflehead	*Bucephala albeola*	--	R/B; C/M,W
Hooded merganser	*Lophodytes cucullatus*	--	R/B,M,W
Common merganser	*Mergus merganser*	--	C/B,M,W
Red-breasted merganser	*Mergus serrator*	--	C/B,M,W

Source: SAIC (2002).

[a] Federal status under the Endangered Species Act of 1973. T = Threatened.
[b] Abbreviations: Acc = Accidental, B = Breeding Bird, C = Common, M = Migration, R = Rare, U = Uncommon, and W = Winter.
Note: Some rare and incidental species are not listed.

Table 3-15. Shorebird Species Occurring in the Cook Inlet Area

Common Name	Scientific Name	ESA Status[a]	Occurrence[b]
Black-bellied plover	*Pluvialis squatarola*	--	C/M
Lesser golden-plover	*Pluvialis dominica*	--	C/M
Semipalmated plover	*Charadrius semipalmatus*	--	C/B,M
Black oystercatcher	*Haematopus bachmani*	--	C/B,M,W
Greater yellowlegs	*Tringa melanoleuca*	--	C/B,M
Lesser yellowlegs	*Tringa flavipes*	--	C/B,M
Solitary sandpiper	*Tringa solitaria*	--	R/B; U/M
Wandering tattler	*Heteroscelus incanus*	--	U/B; C/M
Pribilof Islands rock sandpiper	*Calidris ptilocnemis*	--	C/W
Spotted sandpiper	*Actitis macularia*	--	C/B,M
Whimbrel	*Numenius phaeopus*	--	C/M
Hudsonian godwit	*Kimosa haemastica*	--	U/B,M
Bar-tailed godwit	*Limosa lapponica*	--	U/B,M
Ruddy turnstone	*Arenaria interpres*	--	C/M
Black turnstone	*Arenaria melanocephala*	--	C/M; U/W
Surfbird	*Aphriza virgata*	--	U/B; C/M
Red knot	*Calidris canutus*	--	C/M
Sanderling	*Calidris alba*	--	U/M; R/W
Semipalmated sandpiper	*Calidris pusilla*	--	U/M
Western sandpiper	*Calidris mauri*	--	C/M
Least sandpiper	*Calidris minutilla*	--	C/B,M
White-rumped sandpiper	*Calidris fuscicollis*	--	Acc
Baird's sandpiper	*Calidris bairdii*	--	U/M
Pectoral sandpiper	*Calidris melanotos*	--	C/M
Rock sandpiper	*Calidris ptilocnemis*	--	C/M,W
Dunlin	*Calidris alpina*	--	C/M,W
Short-billed dowitcher	*Limnodromus griseus*	--	C/B,M
Long-billed dowitcher	*Limnodromus scolopaceus*	--	C/M
Common snipe	*Gallinago gallinago*	–	C/B,M; R/W
Red-necked phalarope	*Phalaropus lobatus*	--	C/B,M

Within the lower Cook Inlet area, the largest concentration of seabirds occurs in the Barren Islands. Recent counts and estimates of seabirds on the Barren Islands, supplemented by earlier census data, indicate a total of nearly 420,000 breeding seabirds in these colonies. However, these counts do not include birds at sea (MMS 2003). In addition, this figure includes an estimate of fork-tailed storm petrel population size for only one island—100,000 at East Amatuli—and this species is abundant on at least two other islands in the group. Therefore, it appears that the Barren Islands' actual breeding population is at least 500,000 birds and possibly substantially larger (MMS 2003).

Large seabird colonies also occur at the Chisik-Duck Islands on the west side of the inlet (about 30,000 birds) and on Gull Island in Kachemak Bay (about 20,000 birds). Other colony concentrations occur south of the lease-sale area in Puale and Dry bays (161,000 birds). Smaller colonies are present in Kamishak Bay and on northwestern Afognak and western Shuyak islands (MMS 2003).

The most abundant waterfowl species in the lower Cook Inlet include scoters, long-tailed ducks, eiders, and goldeneyes. Among the shorebirds, western sandpipers, rock sandpipers, and dunlins predominate in the lower inlet at various seasons (MMS 2003). Kachemak Bay was identified recently as a Western Hemisphere Shorebird Reserve because of its importance to shorebirds of the Pacific Flyway.

3.5.5.1 Coastal Birds of Prey

The two major coastal birds of prey in the lease-sale area are the bald eagle and the peregrine falcon. The bald eagle is a breeding, year-round resident along the coasts of lower Cook Inlet and Shelikof Strait. This species is very common along the coast of Kodiak, Afognak, and Shuyak islands; the Alaska Peninsula; and the southern Kenai Peninsula (MMS 2003). During the 1980s, nearly 2,000 eagle nests were counted along the coasts with over 1,400 nests on Kodiak, 298 nests on southern Kenai Peninsula, 277 nests on the south side of the Alaska Peninsula, and 90 nests on the coast of Katmai National Park (MMS 2003). A more recent estimate of the total population for the Kenai Peninsula, Kodiak, and the southern side of the Alaska Peninsula area is about 4,000 eagles. Although bald eagles have not been surveyed in the Cook Inlet region in recent years, populations in southeastern Alaska as a whole have been stable or increasing. Bald eagles feed primarily on fish or act as scavengers (MMS 2003).

In southern Alaska, Peale's peregrine falcons occur along the coast in the Gulf of Alaska south to British Columbia. This subspecies is not listed as threatened or endangered. Some nesting is known to occur on the Barren Islands (MMS 2003). In a 1990 field survey of peregrine falcons conducted in the northern Gulf of Alaska, from the southeastern tip of the Kenai Peninsula northeast through Prince William Sound, investigators recorded the highest nest-site densities along the southern coast of the Kenai Peninsula and concluded that the peregrine falcon population in the study area was healthy. Extrapolation from their population estimate for the entire study area indicates a population of more than 60 adults for the southern Kenai Peninsula. Peregrines frequent the heads of bays, where they prey on seabirds, waterfowl, and shorebirds (MMS 2003).

3.5.6 Nonendangered Marine Mammals

Seven species of nonendangered marine mammals are resident or commonly occur seasonally in the Cook Inlet Planning Area: harbor seals (*Phoca vitulina*); northern fur seals (*Callorhinus ursinus*); harbor porpoises (*Phocoena phocoena*); Dall porpoises (*Phocoenoides dalli*); and killer

(*Orcinus orca*), gray (*Eschrichtius robustus*), and minke (*Balaena acutorostrata*) whales (MMS 2003).

3.5.6.1 Pinnipeds

Harbor seals are distributed in coastal waters along virtually the entire lower Cook Inlet coastline and are generally nonmigratory. Local movements are associated with food and breeding (MMS 2003). Harbor seals occupy a wide variety of habitats in fresh and salt water and along protected and exposed coastlines. They prefer to haul out on gently sloping or tidally exposed habitats including reefs, offshore rocks and islets, mud and sand bars, sand and gravel beaches, and floating and shorefast ice (MMS 2003). Harbor seals tend to have a strong fidelity to traditional haulout sites. Typically, one or two sites are used by an individual in a given area. Important harbor seal haulout areas occur within Kamishak and Kachemak bays and along the coast of the Kodiak Archipelago and the Alaska Peninsula. Pupping appears to take place at most haulouts, and several of these areas contain large numbers of animals (MMS 2003).

Current population estimates for the area are as follows: Gulf of Alaska, 19,450 seals; Cook Inlet, 2,244; Kodiak, 4,437; and the south side of the Alaska Peninsula, 3,200 (Ferrero et al. 2000). The Kodiak population declined steadily from about the mid-1970s to the 1990s, with the Tugidak Island population, once the world's largest concentration, declining by 85 percent between 1976 and 1988, from 6,919 seals to 1,014 (MMS 2003). More recently, this population has increased from 769 seals in 1992 to 1,420 in 1996 (Small 2001). Despite some signs of growth in certain areas, the Gulf of Alaska stock remains low compared with its size in the 1970s and 1980s (Ferrero et al. 2000).

The reason for the decline is unknown, but it mirrors the decline of Steller sea lions (*Eumetopias jubatus*) in the gulf. The harbor seal decline in the Cook Inlet and western Gulf of Alaska area may be related to the crash of the pandalid shrimp and capelin populations in the same area and over the same time period (MMS 2003). Predation by killer whales or sharks, or both, also could be a contributing factor. Losses due to interaction with commercial fishing activities and subsistence harvests are estimated to be about 800 seals per year in the gulf (Ferrero et al. 2000).

Harbor seals are opportunistic feeders whose diet varies with season and location. In the Gulf of Alaska, fish—chiefly pollock and capelin—comprised 74.3 percent of total prey volume; cephalopods, 21.7 percent; and decapod crustaceans, 4.0 percent. Recent scat analysis from Kodiak seals shows Irish lords (43 percent) and sand lances (25 percent) were predominate prey items (MMS 2003).

Northern fur seals range throughout the North Pacific between about 32º and 60º N latitude. The population that breeds in Alaska, primarily on the Pribilof Islands in the Bering Sea, ranges from the Bering Sea and Aleutian Islands eastward through the Gulf of Alaska and southward to California. This population is currently estimated at a minimum of 941,756 seals (Angliss and Lodge 2002). Recent pup counts between 1996 and 2000 have declined; the 2000 count was below 200,000 animals for the first time in over a decade (Angliss and Lodge 2002). The reasons for the more recent population decline (1976–1984) are unknown, but some potential causes are as follows:

- Losses of young seals to entanglement in discarded nets and other fishing gear
- Possible predation by sharks on the fur seals' winter range
- Reduction in the availability of food for young fur seals, potentially related to the buildup of commercial fishing in the Gulf of Alaska
- Changes in environmental factors, such as sea-surface temperature on the winter range (MMS 2003)

Northern fur seals are highly migratory and, with few exceptions, are found in nearly all months of the year throughout their range. Although they lead a pelagic existence when they are not breeding, northern fur seals temporarily haul out on land at nonbreeding sites in Alaska, British Columbia, and the continental United States (MMS 2003). Their distribution in the Gulf of Alaska and throughout their winter range tends to be along the shelf break (200- to 2,000-meter isobaths) and offshore of the shelf break to beyond 100 kilometers (MMS 2003).

Most adult males overwinter in Alaskan waters, while most females and immature males winter in waters off British Columbia, Washington, Oregon, and California. Fur seals can be found year-round in the gulf, although they are most abundant during the spring (April–May) (MMS 2003). The northward migration of individuals wintering in southern parts of the range begins in March, and from April to mid-June, large numbers are found in Gulf of Alaska coastal waters (MMS 2003). In March, seals are still common in Sitka Sound (10.7 seals per survey hour), and numbers are increasing throughout southeast Alaska. By April, the seal migration front reaches the vicinity of Albatross Bank off Kodiak Island; in this area, 11.2 seals have been observed per hour of survey time (MMS 2003).

Fur seals tend to congregate in areas over the outer continental shelf and slope, where nutrient upwelling results in an abundance of various schooling fishes such as capelin, sand lance, pollock, and herring and invertebrates such as squid, on which the seals feed (MMS 2003).

3.5.6.2 Other Pinniped Species

Pacific walruses (*Odobenus rosmarus*) are sighted occasionally in the Gulf of Alaska, particularly in the Cook Inlet area. These unusual sightings generally occur in winter or spring during years when the Bering Sea pack ice extends into the southern Bering Sea and near the Aleutian Islands. Stray walruses apparently move through the passes into the Gulf of Alaska/Shelikof Strait and into Cook Inlet. Adult male northern elephant seals (*Mirounga angustirostris*) seasonally migrate in the spring (late March) and again after the molting season (August to December) from their breeding locations along the California coast into Alaskan waters, presumably to feed on squid and other food sources; and they return to their breeding sites to molt during July (MMS 2003). Individual bull elephant seals have been recorded as far west into Alaskan waters as the western Aleutians. Northern elephant seals have not been recorded in Cook Inlet (MMS 2003).

3.5.6.3 Nonendangered Cetaceans

Dall's Porpoise. Dall's porpoises are present year-round throughout their entire range in the northeast Pacific—from Baja California to Alaska, including the Gulf of Alaska/Cook Inlet area. During most of the year, they inhabit waters deeper than 183 meters (100 fathoms), whereas in winter they occur in deeper water or nearshore at about 91 meters (50 fathoms) (MMS 2003). Their distribution is not as highly correlated with water depth in fall and winter, when they are more evenly dispersed over the entire gulf. Concentrations of Dall's porpoises have been reported in Shelikof Strait and around Kodiak and Afognak Islands. The current Alaska population estimate is 83,400 animals, with a minimum stock of 76,874 (Ferrero et al. 2000).

Dall's porpoise usually travel in groups of 10–20 animals. Larger groups containing more than 200 individuals have been reported; in 1980 a group of 3,000 was observed in southeast Alaska (MMS 2003). Although adults with calves have been seen in spring in the North Pacific, most breeding and births probably occur from June to August with calving centered in early July (MMS 2003). Dall's porpoises consume squid, crustaceans, and deepwater fish such as saury, hake, herring, and jack mackerel (MMS 2003).

Gray Whale. The current estimate of the eastern Pacific stock of gray whales is 26,635 whales, with a minimum of 24,477 animals (Angliss and Lodge 2002). Evidence that the population is approaching or may have exceeded pre-exploitation levels prompted the NMFS to issue a determination that the eastern North Pacific stock be removed from the list of Endangered and Threatened Wildlife (59 *FR* 31094. June 16, 1994)).

Most gray whales calve and breed from late December to early February in protected waters along the western coast of Baja California. Recent observations suggest that some calving occurs as far north as Washington prior to arrival on the calving grounds (MMS 2003).

Northward migration, primarily of individuals without calves, begins in February; some cow/calf pairs delay their departure from the calving area until well into April (MMS 2003). Gray whales approach the Cook Inlet Planning Area in late March, April, May, and June and again in November and December (MMS 2003). Although there have been numerous sightings of gray whales in Shelikof Strait, most of the population follows the outer coast of the Kodiak Archipelago from the Kenai Peninsula in spring or the Alaska Peninsula in fall. Spring concentrations occur along eastern Afognak Island and the northeastern, central, and southeastern Kodiak Island area during the spring and fall migrations. Gray whale concentrations have been reported in Shelikof Strait, along the west side of Kodiak Island, during the fall (MMS 2003).

The majority of the eastern Pacific gray whale population feeds primarily in the northern Bering and southern Chukchi seas during the summer months. A portion of the population summers and feeds along the eastern Pacific coast of California, Oregon, Washington (Puget Sound), and British Columbia (Vancouver Island) (MMS 2003). Epibenthic and infauna amphipod crustaceans appear to be the primary prey species; polychaete worms, mollusks, and schooling fish also are taken. It is reasonable to speculate that similar feeding occurs along the Gulf of Alaska coast because as the eastern Pacific population of gray whales recovered to its pre-exploitation level, the whales returned to using all benthic-prey resources available along the coast of their migration route and throughout their summer range (MMS 2003).

Harbor Porpoise. The current estimate of abundance for the Gulf of Alaska is 21,451 harbor porpoises, with a minimum estimate of 16,630 (Ferrero et al. 2000). Densities were reported as 0.72 porpoises per square kilometer in Cook Inlet, 2.62 porpoises per square kilometer in the Kodiak area, and 2.23 porpoises per square kilometer along the southern Alaska Peninsula (MMS 2003). In spring and summer, harbor porpoise sightings are numerous in the Kodiak Island area and Kachemak Bay. Harbor porpoises have been observed in Cook Inlet and Shelikof Strait during winter months. Harbor porpoises usually occur singly or in pairs (MMS 2003).

The migratory movements of harbor porpoises are not well defined, but the porpoises are reported to move north in late May and south in early October on the Atlantic coast. In addition, they are believed to move inshore in summer and offshore in winter; the decline in numbers of porpoises in Prince William Sound also suggests winter dispersion (MMS 2003). Harbor porpoises generally are observed in harbors, bays, and river mouths. They also are seen concentrated in and along turbid river-water plumes, such as the Copper River and Icy Bay areas. Mating probably occurs from June or July to October, with peak calving in May and June (MMS 2003).

Harbor porpoises consume a wide variety of fish and cephalopods, apparently preferring nonspiny, schooling fish such as herring, mackerel, and pollock (MMS 2003). An important cause of local mortality of harbor porpoises is incidental catches in setnet and driftnet fisheries throughout the western coast of North America (MMS 2003).

Killer Whale. The North Pacific killer whale population is regarded as abundant in the Gulf of Alaska/Cook Inlet region. More than 700 killer whales (orcas) have been identified in the gulf (Dalheim and Waite 1992). The current minimum estimate of resident whales in the eastern North Pacific is 717 animals (Ferrero et al. 2000). In spring, killer whales are found throughout the gulf in shallow waters less than 200 meters deep. The peak breeding period is May through July. In summer, they apparently are more concentrated in the Kodiak Island area. The movement of resident killer whales (a pod or family group of whales that remains year-round within an area or territory such as in part of Prince William Sound) in nearshore waters—especially in summer and fall—is in part related to inshore migrations of pelagic fish, such as salmon and other shoaling fish, which are common prey species in these areas (MMS 2003). In fall and winter, killer whales are numerous around Kodiak and in adjacent shelf waters but not elsewhere in the gulf. Group or pod size varies from 1 to 100, but only 1 percent of these pods contain more than 20 whales. An aggregation estimated to contain 500 was recorded near Middleton Island in April 1972 (MMS 2003).

Other pods of nonresident or transient killer whales are believed to move over broader ranges of territory than do resident pods and prefer to feed on other marine mammals, such as seals; porpoises; dolphins; and beluga, sperm, and baleen whales (MMS 2003).

Minke Whale. The North Pacific minke whale population, including the Gulf of Alaska population, is categorized as abundant. However, there are no estimates available on the number of minke whales in Alaska (Ferrero et al. 2000). In spring, most minke whales are found throughout the outer continental shelf, especially in shallow, nearshore coastal waters. Minke whales are most abundant in the gulf during summer, when they appear to become more sedentary in their movements, sometimes occupying individual seasonal local feeding ranges.

Concentrations of minke whales have occurred along the north coast of Kodiak Island and along the south coast of the Alaska Peninsula. Minke whales become scarce in the gulf in fall; most whales probably leave the region by October (MMS 2003).

The migratory patterns of the minke whale are not well defined. In the western North Pacific, there is no obvious migration from lower latitudes, and the species is found year-round in the Bering Sea (MMS 2003). Adults and some adolescents travel to northernmost feeding areas, and most immature individuals remain in southern waters. Minke whales feed on a variety of small schooling fish and euphausiids by using lung-feeding or bird-associated feeding strategies (MMS 2003).

3.5.6.4 Other Nonendangered Cetaceans

Other nonendangered cetaceans that rarely or infrequently occur in the Gulf of Alaska/Cook Inlet region include the short-finned pilot whale, Risso's dolphin, northern right whale dolphin, north Pacific giant bottlenose whale, goosebeak whale, and Bering Sea beaked whale (MMS 2003).

3.5.7 Contaminants in Cook Inlet Marine Biota

Sampling data were collected by EPA Office of Water (OW), Office of Science and Technology with assistance from Port Graham and Nanwalek Tribal residents and professional staff. The field sampling was conducted between June 5 and July 24, 1997. EPA's summary report of these data include only chemical concentrations which were detected, the average, maximum and minimum values. In May 2003, the Port Graham Village Council petitioned the Agency for Toxic Substances and Disease Registry (ATSDR) to review the data presented in EPA's *Survey of Chemical Contaminants in Fish, Invertebrates and Plants Collected in the Vicinity of Tyonek, Seldovia, Port Graham and Nanwalek, Cook Inlet, Alaska*. EPA's contaminant survey report was finalized in December 2003 (USEPA 2003). ATSDR's health consult, entitled *Evaluation of Biota Data Collected in the Vicinity of Tyonek, Seldovia, Port Graham, and Nanwalek, AK*, has been released for public comment in draft form. The discussion below summarizes EPA's contaminant survey and presents the ATSDR's draft findings related to the various contaminants.

EPA's OW collected and analyzed a total of 81 tissue samples comprising seven fish species, eight invertebrates and three plant species (Table 3-16). Samples were analyzed for 161 chemicals in five chemical groups (metals, PAHs, pesticides, polychlorinated biphenyl (PCB), and dioxins/furans). ATSDR's draft report concluded that these five chemical groups pose no apparent public health hazard (ATSDR 2006). EPA testing failed to detect approximately one-half (85) of the analytes in any sample, while approximately one-half (76) of these chemical were detected. The numbers of detected chemicals by sample type and chemical group are shown (Table 3-17). These results provide a good survey data set for environmental chemicals present in uncooked, whole body tissues samples of these Cook Inlet biota. There were detections of global contaminants: mercury, organochlorine pesticides, and PCB congeners. On the other hand, there was minimal detection of another ubiquitous contaminant group, dioxins and furans. In the 81 tissue samples analyzed for dioxin and furan congeners, only one type of dioxin, OCDD, was detected in one duplicate chinook salmon sample (13 ppt) (USEPA 2003).

Table 3-16. Characteristics of Species Sampled in the Study

Common Name	Scientific Name	Size Range (cm)	Sample Type
Fish			
Chinook salmon	*Oncorhynchus tshawytscha*	59.7–96.5	Whole body
Chum salmon	*Oncorhynchus keta*	57.2–73.7	Whole body
Sockeye salmon	*Oncorhynchus nerka*	40.6–76.2	Whole body
Sea bass	*Sebastes melanops*	30.5–58.4	Whole body
Cod	*Gadus macrocephalus*	58.4–81.3	Whole body
Flounder	*Lepidopsetta bilineata*	27.9–41.9	Whole body
Halibut	*Hippoglossus stenolepis*	67.3–101.6	Whole body
Invertebrates			
Blue mussel	*Mytilus* cf. *trossulus* sp.	Not reported	Whole body without shell
Mussel	Not determined	Not reported	Whole body without shell
Butter clam	*Saxidomus giganteus*	Not reported	Whole body without shell
Large clam	Not determined	Not reported	Whole body without shell
Steamer clam	*Protothaca staminea*	Not reported	Whole body without shell
Chiton	*Polyplacophora* sp.	Not reported	Whole body without shell
Octopus	Octopodidae	Not reported	Whole body
Snail	*Littorina* sp.	Not reported	Whole body without shell
Plants			
Goose tongue	*Plantago maritime*	Not reported	Edible “tongue” portion
Kelp/bull kelp	*Nereocystis luetkeana*	Not reported	Edible bulb portion
Seaweed	*Porphyra* sp.	Not reported	Blades

Source: USEPA (2003).

Table 3-17. Number of Samples in which Chemical Was Detected

Sample Type	Number of Samples	Number of Samples in Which Chemical Was Detected					
		Metals	PAHs	Pesticides	Aroclors	PCB Congeners	Dioxins/ Furans
Fish[a]	33	33	33	33	5	33	1
Shellfish[b]	15	15	10	1	0	1	0
Other Invertebrate[c]	21	21	19	8	0	8	0
Plants[d]	12	12	9	1	0	0	0

Source: USEPA (2003).

[a] Chinook salmon, chum salmon, sockeye salmon, sea bass, cod, flounder, halibut.

[b] Blue mussel, mussel, butter clam, large clam, steamer clam.

[c] Chiton, octopus, snail.

[d] Goose tongue, kelp, seaweed.

Detectable concentrations of dioxins and furans were not found in other Cook Inlet tissue samples. The detection of many individual PAH compounds in the Cook Inlet tissue samples may have resulted from the use of very sensitive methods. Approximately one-half of the 104 individual PAHs were detected in fish, invertebrate and plant samples. Chinook tissue samples had the highest total average PAH concentration (253 ppb).

The biota species which were sampled, the size of the biota and the harvest locations were intended to represent those traditionally used by members of the four Alaskan tribal villages of Tyonek, Seldovia, Port Graham and Nanwalek (Figure 3-11). However, all possible harvest sites were not evaluated. Not all fish, invertebrate and plant species consumed in a traditional diet were included in this survey. It is unlikely that this one-time sampling is representative of contaminant concentrations in these species over the entire lifetime of a human who consumes these species. Whole-body samples such as these are representative of exposures to the biota, itself, or predators that consume the whole body. Combining several individuals into a single sample (composite sample) precluded the availability of chemical concentration data for individual fish, invertebrate or plant samples.

These data contain no definitive information to distinguish wild versus hatchery or pen-raised fish. The sensitivity of the analytical methods used in this study should be carefully considered when using these data. In some cases, the methods were more sensitive than data sets for other comparable fish samples (e.g. polycyclic aromatic hydrocarbons). But, there were also cases in which the methods were less sensitive than other data sets (e.g., dioxins and furans). Comparisons were made with market basket food contaminant data published elsewhere and with Columbia River (Washington, Oregon USA) fish contaminant data. With few exceptions, contaminant concentrations in Cook Inlet area species were similar or lower (USEPA 2003).

3.5.7.1 PCBs

The 81 tissue samples consisting of fish, invertebrates, and plants were analyzed for 7 commercial PCB mixtures (Aroclors) and 13 individual coplanar PCB congeners. Aroclor 1260 was the only Aroclor detected and was found only in Chinook salmon, chum salmon, and sea bass. Aroclor 1260 was detected in 5 of 81 tissue samples analyzed (Table 3-18). Five of the 13 PCB congeners (114, 126, 157, 169, and 189) were not detected in any of the tissue samples analyzed (USEPA 2003).

PCB congeners 118, 170, and 180 were detected in all seven fish tissue samples. With the exceptions of flounder and sea bass, PCB congener 118 occurred at higher concentrations than any of the other congeners (range of averages 39–593 ppt). PCB congener 180 was detected at the highest concentrations in flounder and sea bass (range of averages 55–807 ppt). PCB congener 77 was present at the lowest concentrations (range of averages 3–9 ppt) (USEPA 2003).

All eight of the detected PCB congeners were found in Chinook salmon tissues. Sea bass tissue samples contained the highest sum of averages of all PCB congeners (2,030 ppt), while flounder tissue samples contained the lowest sum of averages of all PCB congeners (135 ppt) (USEPA 2003).

PCB congeners were detected only in butter clam, octopus, and snail. PCB congener 77 was detected in one butter clam sample (9 ppt), while PCB congeners 118 and 180 were detected in octopus tissue samples (averages ~ 24 ppt). PCB congeners 170 and 180 were detected in snail tissue samples (average 23 ppt and 57 ppt, respectively) (USEPA 2003).

PCB congener 118, the only congener detected in plant tissue, was detected in seaweed at an average concentrations of 45 ppt (USEPA 2003).

3.5.7.2 PCDDs and PCDFs

PCDDs and PCDFs were rarely detected in tissue samples collected from Cook Inlet. In the 81 tissue samples analyzed, only one congener, octachlorodibenzo-p-dioxin (OCDD), was detected in a duplicate Chinook salmon sample (13 ppt) (Table 3-19) (USEPA 2003).

Table 3-18. Aroclor 1260 and PCB Congener Concentrations in Seafood Items Collected in Cook Inlet[a]

	Aroclor 1260		PCB Congeners (ng/kg)[b]															
			77		105		118		123		156		167		170		180	
Species	**Max**	**Avg**	**Max**	**Avg**	**Max**	**Avg**	**Max**	**Avg**	**Max**	**Avg**	**Max**	**Avg**	**Max**	**Avg**	**Max**	**Avg**	**Max**	**Avg**
Fish																		
Chinook salmon	3,200	3,200	12.9	9.1	220	181	521	443	13	11	38	33	23	21	48.3	53.3	209	185
Chum salmon	4,400	4,400	3.89	3.74			135	128							21.1	20.1	64.7	54.9
Cod							137	119	106	106					30.9	28.2	93.6	80.5
Flounder							103	39							56	34	133	63
Halibut			3.39	2.73	101	102	251	207			20.5	20.1			47.8	40.6	154	125
Sea bass	6,260	6,260			344	282	953	593	13	12			42	31	398	305	1,440	807
Sockeye salmon			6.71	2.73	106	100	265	231			26	23			39	33	121	107
Invertebrates																		
Blue mussel																		
Butter clam			9.61	9.61														
Chiton																		
Large clam																		
Mussel																		
Octopus							25	24	45								49.6	41.9
Snail															28.3	23.4	81.8	57.6
Steamer clam																		
Plants																		
Goose tongue																		
Kelp																		
Seaweed						71	45											

Source: USEPA (2003).
[a] Empty cell indicates the analyte was below detection limits.
[b] ng/kg = nanograms/kilogram (parts per trillion=ppt).

Table 3-19. PCDD/PCDF[a] and Total PAH[b] Concentrations in Seafood Items Collected in Cook Inlet[c]

	PCDD/PCDF (ng/kg)[a]		Total PAHs (mg/kg)[b]	
Species	**Maximum**	**Average**	**Maximum**	**Average**
Fish				
Chinook salmon	13.1	13.1	253	253
Chum salmon			48	48
Cod			1	1
Flounder			60	60
Halibut			44	44
Sea bass			87	87
Sockeye salmon			33	33
Invertebrates				
Blue mussel			14	14
Butter clam			16	16
Chiton			12	12
Large clam			3	3
Mussel				
Octopus			5	5
Snail			34	34
Steamer clam			5	5
Plants				
Goose tongue			133	133
Kelp			14	14
Seaweed			5	5

Source: USEPA (2003).

[a] PCDD: polychlorinated dibenzo-p-dioxins; PCDF: polychlorinated dibenzofurans; ng/kilogram = nongrams/kilogram (parts per trillion-ppt).
[b] PAH: polycyclic aromatic hydrocarbons; mg/kg = milligrams/kilogram (parts per million=ppm).
[c] Empty cells indicate that the analyte was below detection limits.

3.5.7.3 PAHs

Fish. The 81 tissue samples of fish, invertebrates, and plants were analyzed for 104 PAHs. Approximately one-half of these PAHs were detected in the Cook Inlet tissue samples. PAHs were detected in all fish tissue samples (Table 3-19). Total PAHs average concentrations ranged from 1 to 253 ppb. The highest average concentrations were detected in Chinook tissue samples; the lowest average concentrations were detected in cod tissue samples (USEPA 2003).

Invertebrates. Except for mussel tissue samples, PAHs were detected in all invertebrate tissue samples (Table 3-19). Total PAH average concentrations ranged from 3 to 34 ppb. The highest average concentrations were detected in snail tissue samples; the lowest average concentrations were detected in large clam tissue samples (USEPA 2003).

Plants. PAHs were detected in all plant tissue samples, with total PAH average concentrations ranging from 5 to 133 ppb (Table 3-19). The highest average concentrations were detected in goose tongue tissue samples. Pyrene was detected in one sample of goose tongue (with an average of 4.1 ppb) (USEPA 2003).

ATSDR reviewed data on PAH concentrations from various sources and ultimately determined that the data on exposure pathways was insufficient to draw firm conclusions. ATSDR therefore reported that PAHs pose an indeterminate public health risk (ATSDR 2006).

3.5.7.4 Pesticides

Tissue samples were analyzed for 13 organochlorine pesticides: DDT and its metabolites (DDD and DDE), chlordane compounds, dieldrin, endosulfan, endrin, heptachlor epoxide, hexachlorobenzene, lindane, mirex, and pentachloroanisole.

Fish. Pesticides were detected in all fish tissue samples (Table 3-20). Average concentrations were less than 12,000 ppt. The lowest average concentrations were detected in flounder tissue samples (1,243 ppt) and highest average concentrations were detected in Chinook and sea bass tissue samples (11,324 and 11,090 ppt, respectively). Chinook and sockeye tissue samples contained the greatest number of organochlorine pesticides—9 out of 13—and had similar proportions of the 9 detected pesticides (USEPA 2003).

The highest concentrations of several pesticides—hexachlorobenzene, endrin, and dieldrin—were measured in Chinook salmon tissue samples. The highest concentrations of DDT compounds, chlordanes, heptachlor epoxide, and mirex were detected in sea bass tissue samples. The highest concentrations of endosulfans, lindane and pentachloroanisole were detected in sockeye tissue samples (Table 3-20) (USEPA 2003).

The concentration of DDT compounds (Total DDT) was estimated as the sum of the isomers—2,4-DDD; 2,4-DDE; 2,4-DDT; 4,4-DDE; 4,4-DDD; and 4,4-DDT. DDT compounds were detected in all fish tissue samples, and represented the greatest organochlorine pesticide concentration (range of averages 588 to 5,894 ppt). Highest average concentrations were detected in sea bass tissue samples (5,894 ppt), and lowest average concentrations were detected in flounder tissue samples (588 ppt) (Table 3-20). DDE isomer concentrations were present in the greatest amount followed by DDT, then DDD concentrations (USEPA 2003).

The concentration of total chlordanes was estimated as the sum of alpha-chlordane, cis-nonachlor, gamma-chlordane, oxychlordane and trans-nonachlor. Chlordane compounds were detected in all species, except halibut. Highest average concentrations were detected in sea bass tissue samples

(2,732 ppt), and the lowest average concentrations were detected in flounder tissue samples (372 ppt) (Table 3-20) (USEPA 2003).

Table 3-20. Pesticide Concentrations (ng/kg – ww)[a] in Seafood Items Collected in Cook Inlet[b]

	Total DDT		Chlor-dane		Dieldrin		Endo-sulfan		Endrin		Hepta-chlor Epoxide		Hexa-chloro-benzene		Lindane		Mirex		Penta-chloro-anisole		Total of
Species	**Max**	**Avg**	**Max**	**Avg**	**Max**	**Avg**	**Max**	**Avg**	**Max**	**Avg**	**Max**	**Avg**	**Max**	**Avg**	**Max**	**Avg**	**Max**	**Avg**	**Max**	**Avg**	**Avg.s**
Fish																					
Chinook	NA	5398	2370	1227	1720	769	780	544	813	582	276	238	2040	1787	203	185			1180	594	11,324
Chum	NA	2016	1140	717									1040	696							3,429
Cod	NA	1951	657	379	242	237							242	237							2,804
Flounder	NA	588	587	372									286	283							1,243
Halibut	NA	2902			593	419			407	407			1590	1280					309	226	5,234
Sea bass	NA	5894	7490	2732	477	477					310	310	913	798			417	379	500	500	11,090
Sockeye	NA	3123	2190	777	473	382	1610	664	947	483	251	174	1450	1124	793	275			8930	1919	8,921
Invertebrates																					
Blue mussel																					
Butter clam																					
Chiton									309	266	207	207			175	175					648
Large clam																					
Mussel													301	301							301
Octopus																					
Snail													747	624	155	155					779
Steamer clam																					
Plants																					
Goose tongue	218	218[c]																			218
Kelp																					
Seaweed																					

Source: USEPA (2003).

[a] ng/kg - ww = nanograms/kilogram wet weight (parts per trillion=ppt)

[b] Empty cells indicate that the analyte was below detection limits.

[c] Only DDD isomers were detected in this sample.

Hexachlorobenzene was detected in all fish species. Highest average concentrations were detected in Chinook tissue samples (1,787 ppt), and lowest average concentrations were detected in cod tissue samples (237 ppt) (Table 3-20) (USEPA 2003).

Dieldrin was not detected in chum salmon or flounder tissue samples. Highest average concentrations were detected in Chinook tissue samples (769 ppt), and lowest average concentrations were detected in cod tissue samples (237 ppt) (Table 3-20) (USEPA 2003).

Endosulfans were detected only in Chinook and sockeye salmon tissue samples (averages 544 and 664 ppt, respectively). Endrin was detected only in Chinook, halibut, and sockeye (range of averages 407 to 582 ppt). Heptachlor epoxide was detected only in Chinook, sea bass, and sockeye tissue samples. Average concentrations in Chinook and sea bass tissue samples were 238 ppt and 310 ppt, respectively; average concentrations in sockeye tissue samples were 174 ppt. Lindane was detected only in Chinook and sockeye tissue samples (averages 185 and 275 ppt, respectively). Mirex was detected only in sea bass tissue samples (average 379 ppt). Pentachloroanisole was detected in Chinook, halibut, and sockeye tissue samples. Highest average concentrations were detected in sockeye tissue samples (1,919 ppt), and lowest average concentrations were detected in halibut tissue samples (226 ppt) (Table 3-20) (USEPA 2003).

Invertebrates. Organochlorine pesticides were infrequently detected in invertebrates. The chlordane compounds, DDT compounds, dieldrin, endosulfans, and mirex were not found in any invertebrates collected from Cook Inlet. The only organochlorine pesticide compounds detected in invertebrate tissue samples were endrin (chiton, average 266 ppt), lindane (chiton and snail, average 175 and 155 ppt, respectively), heptachlor epoxide (chiton, average 207 ppt), and hexachlorobenzene (mussel and snail, average 301 and 624 ppt, respectively) (Table 3-20) (USEPA 2003).

Plants. Three plant species were tested in this study, and only DDD was detected in one of the goose tongue samples (218 ppt) (Table 3-20) (USEPA 2003).

3.5.7.5 Trace Metals

Fish. Tissue analyses of trace elements included arsenic (total), barium, cadmium, chromium, lead, mercury, methylmercury, and selenium. The total average concentration of metals ranged from 1.4 ppm to 5.8 ppm. The highest total concentrations were in cod tissue samples (average 5.8 ppm) (Table 3-21). Arsenic was detected in all fish species samples. The lowest total concentrations were in Chinook tissue samples (average 1.4 ppm). Arsenic, barium, chromium, methylmercury, and selenium were detected in all seven species of fish. Lead was detected only in Chinook and flounder (average 4.2 ppm in both) (Table 3-21) (USEPA 2003). ATSDR found that arsenic exposure from Cook Inlet biota likely poses no apparent public health hazard (ATSDR 2006).

The highest concentrations of chromium were found in sockeye salmon tissue samples (maximum of 11.7 ppb, average of 1.9 ppm) (Table 3-21). Average arsenic concentrations ranged from 0.24 to 4.2 ppm. The highest average arsenic (total) concentrations were detected in cod tissue samples, while the lowest average arsenic concentrations were detected in chum salmon. With the exception of chum and sockeye salmon tissue, arsenic accounted for the greatest percentage of the metals concentrations. Inorganic arsenical species were detected in four fish species. Trivalent arsenic and monomethylarsenic concentrations were detected only in flounder tissue

Table 3-21. Trace Metal Concentrations (mg/kg – ww)[a] in Seafood Items Collected in Cook Inlet[b]

Species	Total Arsenic		Barium		Cadmium		Chromium		Lead		Total Mercury		Methyl Mercury		Selenium	
	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg
Fish																
Chinook	709	541	139	139	141	109	267	184	42	42	49.9	40.5	49	39	405	371
Chum	252	241	833	803	58	57	573	417			21.9	21.9	19.9	19.8	599	536
Cod	5,190	4,207	722	443			689	543			57.8	45.8	45.8	38.3	575	568
Flounder	6,300	2,917	948	912	74	48	855	355	128	42	43	30	47	22	1,580	524
Halibut	1,500	1,297	172	129	57	39	459	353					47	33	505	481
Sea bass	1,060	792	864	656	89	62	702	385					122	75	633	590
Sockeye	399	345	289	221	58	37	11,700	1,954					19.8	15	691	621
Invertebrates																
Blue mussel	1,330	1,203	462	253	516	465	288	188	47	43	12.2	11.3	4.01	3.06	337	304
Butter clam	5,030	3,963	1,230	1,063	107	100	3,790	2,000	80	59	16.9	15.6	6	5	415	321
Chiton	2,050	1,711	1,610	668	1,080	769	1,230	612	461	255			2.16	2.16	238	229
Large clam	3,340	3,180	886	793	95	87	1,470	1,042	41	41			6	6	394	354
Mussel	1,080	967	170	129	338	302	259	242	32	31			2.03	1.84	341	323
Octopus	3,610	2,958	461	308	1,560	1123	271	188	25	19			9.59	7.90	432	379
Snail	3,700	2,919	637	301	10,100	4,493	936	377	46	38			8.07	5.39	812	559
Steamer clam	2,950	2,390	652	585	273	224	364	307					5.42	3.80	375	354
Plants																
Goose tongue	15	13	167	112			142	128	30	26						
Kelp	2,720	2,557	466	363	374	301	504	232	25	25					172	135
Seaweed	4,250	2,873			779	510	333	185								

Source: USEPA (2003)

[a] mg/kg - ww = milligrams/kilogram wet weight (parts per million=ppm)

[b] Empty cells indicate that the analyte was below detection limits.

samples (averages of 0.012 and 0.013 ppm, respectively). Dimethylarsenic acid concentrations were detected in tissue samples of cod, halibut, and sea bass (range of averages from 0.024 to 0.055 ppm) (USEPA 2003).

With the exception of cod fish tissues, cadmium was detected in all fish tissue samples (range of averages from 37 to 109 ppb). Average concentrations of methylmercury ranged from 15 to 75 ppb. The highest average methylmercury concentrations were in sea bass, while the lowest average methylmercury concentrations were in sockeye salmon (Table 3-21) (USEPA 2003).

Selenium was detected in all fish tissue samples, with the highest mean tissue concentration measured in sockeye salmon tissue samples (621 ppb). However, the highest maximum concentration was measured in flounder tissue samples (1,580 ppb) (Table 3-21) (USEPA 2003).

Invertebrates. Arsenic, barium, cadmium, chromium, methylmercury, and selenium were detected in all eight invertebrate species' tissue samples. Lead was detected in all tissue samples, except steamer clams. The average concentrations of total metals in invertebrates ranged from 0.3 to 8.4 ppm (Table 3-21). The highest total average concentrations were found in snail tissue samples, with the lowest total average concentrations found in mussel tissue samples. In most cases, total arsenic contributed the greatest percentage of total metals (range of averages from 40 percent to 81 percent) (EPA 2003). Again, ATSDR reported that arsenic exposure from Cook Inlet biota likely poses no apparent public health hazard (ATSDR 2006). Cadmium contributed the greatest percentage (54 percent), in snail tissue samples (USEPA 2003).

Total arsenic average concentrations ranged from 0.013 to 3.9 ppm (Table 3-21). The highest average arsenic concentrations were detected in butter clam tissue samples, and the lowest average total arsenic concentrations were detected in mussel tissue samples. Trivalent arsenic was detected in tissue samples from blue mussels, butter clam, large clam, steamer clam, and snail (range of averages from 0.005 to 0.053 ppb). Snail tissue samples had the highest trivalent arsenic concentrations. Dimethylarsenic acid concentrations were detected in all invertebrate tissue samples (range of averages from 0.031 to 0.208 ppm). Monomethylarsenic concentrations were not detected in any tissue samples (USEPA 2003).

Chromium was detected in all invertebrate tissue samples, with the highest mean tissue concentrations measured in butter clams (2.0 ppm) and large clams (1.0 ppm). Mean tissue concentrations in these two species were approximately 10 times higher than other invertebrate tissue samples, which ranged from approximately 0.188 to 0.612 ppm (Table 3-21) (USEPA 2003).

Methylmercury average concentrations were detected in all invertebrate tissue samples (Table 3-21). Average methylmercury concentrations ranged from 1.8 to 7.9 ppb. The highest average methylmercury concentrations were detected in octopus tissue samples, while the lowest average methylmercury concentrations were detected in chiton tissue samples (Table 3-21) (USEPA 2003).

Plants. Metals were detected in the three plant species analyzed. Barium was detected in goose tongue and kelp tissue samples (averages of 112 and 363 ppb, respectively) (Table 3-21). Cadmium concentrations were detected in kelp and seaweed (averages of 301 and 510 ppb, respectively). Mean chromium concentrations detected in the three plant species ranged from 128 to 232 ppb. Lead concentrations were detected in goose tongue and kelp (averages of 26 and 25 ppb, respectively). The mean selenium concentration detected in kelp was 135 ppb (Table 3-21) (USEPA 2003). Because of insufficient amount of data available for arsenic in plants, ATSDR concluded that inorganic arsenic in plants poses an indeterminate public health hazard (ATSDR 2006).

Cook Inlet Beluga Whales. Tissues from Cook Inlet beluga whales, *Delphinapterus leucas*, that were collected as part of the Alaska Marine Mammal Tissue Archival Project were analyzed for PCBs, chlorinated pesticides, and heavy metals and other elements. Concentrations of total PCBs, total DDT, chlordane compounds, hexachlorobenzene, dieldrin, mirex, toxaphene, and hexachlorocyclohexane measured in Cook Inlet beluga blubber were compared with those reported for belugas from two Arctic Alaska locations (Point Hope and Point Lay), Greenland, Arctic Canada, and the highly contaminated stock from the St. Lawrence estuary in eastern Canada (Becker et al. 2000).

The Arctic and Cook Inlet belugas had much lower concentrations (PCBs and DDT were an order of magnitude lower) than those found in animals from the St. Lawrence estuary. The Cook Inlet belugas had the lowest concentrations of all (PCBs averaged 1.49 ± 0.70 and 0.79 ± 0.56 mg/kg wet mass, and DDT averaged 1.35 ± 0.73 and 0.59 ± 0.45 mg/kg in males and females, respectively) (Becker et al. 2000). Concentrations in the blubber of the Cook Inlet males were significantly lower than those found in the males of the Arctic Alaska belugas (PCBs and DDT were about half). The lower levels in the Cook Inlet animals might be due to differences in contaminant sources, food web differences, or different age distributions among the animals sampled.

Cook Inlet males had higher mean and median concentrations than did females, a result attributable to the transfer of these compounds from mother to calf during pregnancy and during lactation. Liver concentrations of cadmium and mercury were lower in the Cook Inlet belugas (most cadmium values were < 1 mg/kg and mercury values were 0.704–11.42 mg/kg wet mass), but copper levels were significantly higher in the Cook Inlet animals (3.97–123.8 mg/kg wet mass) than in Arctic Alaska animals and similar to those reported for belugas from Hudson Bay. Although total mercury levels were the lowest in the Cook Inlet population, methylmercury concentrations were similar among all three groups of the Alaska animals examined (0.34–2.11 mg/kg wet mass). As has been reported for the Point Hope and Point Lay belugas, hepatic concentrations of silver were relatively high in the Cook Inlet animals and positively correlated with mercury and selenium concentrations in the liver (Becker et al. 2000).

3.5.8 Terrestrial Mammals

Approximately 38 species of terrestrial mammals occur in the lower Cook Inlet region, with about 20 of these species present on the Kodiak Archipelago. Table 3-22 lists the major terrestrial mammals occurring in the Cook Inlet area. Ten mainland species that use the marine coastal environments to some degree are the river otter, brown bear, black bear, red fox, arctic fox, wolf, coyote, mink, wolverine, and moose. In the Cook Inlet/Kodiak Archipelago area, the river otter, brown bear, and black-tailed deer use the coastal marine environment to a significant degree. Descriptions of these species’ use of coastal habitats in the lower Cook Inlet area follows.

Table 3-22. Occurrence of Terrestrial Mammals in the Upper Cook Inlet Area

Common Name	Scientific Name
Masked shrew	*Sorex cinereus*
Dusky shrew	*Sorex monticolus*
Water shrew	*Sorex palustris*
Pigmy shrew	*Sorex hoyi*
Little brown bat	*Myotis lucifugus*
Collared pika	*Ochotona collaris*
Snowshoe hare	*Lepus americanus*
Arctic ground squirrel	*Spermophilus parryii*
Hoary marmot	*Marmota caligata*
Red squirrel	*Tamiasciurus hudsonicus*
Beaver	*Castor canadensis*
Northern red-backed vole	*Clethrionomuys rutilus*
Tundra vole	*Microtus oeconomus*
Singing vole	*Microtus miurus*
Muskrat	*Ondatra zibethicus*
Brown lemming	*Lemmus sibiricus*
Northern bog lemming	*Synaptomys borealis*
Meadow jumping mouse	*Zapus hudsonicus*
Porcupine	*Erthizon dorsatum*
Coyote	*Canis latrans*
Wolf	*Canis lupus*
Red fox	*Vulpes vulpes*
Black bear	*Ursus americanus*
Brown bear	*Ursus arctos*
Marten	*Martes americana*
Ermine	*Mustela erminea*
Mink	*Mustela vison*
Wolverine	*Gulo gulo*
River otter	*Lutra canadensis*
Lynx	*Lynx canadensis*
Moose	*Alces alces*
Black-tailed deer	*Odocoileus hemionus sitkensis*

Source: SAIC (2002).

3.5.8.1 River Otters

River otters frequently occur in nearshore waters all along the coast of the proposed lease-sale area, where they forage on small fish, clams, crustaceans, and other invertebrates. They also use the beaches and intertidal areas. Sculpins and rockfish were reported to be predominant prey items of river otters occurring along the coast of southeastern Alaska. River otters in Alaska breed in May, with mating occurring in and out of the water. One to six pups are born to a female otter from late January to June. River otters reach sexual maturity at 2 years and live up to 20 years. Family units of an adult female and her pups, with or without an adult male, travel only a few miles. Larger groups of neighboring family units of more than 10 individuals form temporary associations. These groups travel over a wide area and apparently do not have exclusive territories (MMS 2003).

3.5.8.2 Brown Bears

Brown bears are found throughout most of the Kodiak Archipelago and on all the mainland adjacent to the proposed lease-sale area. Brown bear densities are highest (more than 175 bears per 1,000 square kilometers) on the Kodiak Archipelago and along the Alaska Peninsula and Kamishak Bay, with lower densities (50–175 bears per 1,000 square kilometers) on the west side of Cook Inlet and more than 50 bears per 1,000 square kilometers on the Kenai Peninsula. The estimated brown bear population of Kodiak and adjacent islands is 2,800–3,000 animals, and the estimated density is 1.12 bears per square kilometer (MMS 2003). The estimated brown bear population for the Alaska Peninsula in 1989 was 5,679 (MMS 2003). The brown bear population of Katmai National Park recently was estimated at between 1,500 and 2,000 bears; the density along the coast of Katmai was estimated at 537 bears per 1,000 square kilometers (MMS 2003). Brown bears use the coastal areas from about April to November. During spring, bears rely heavily on coastal beaches, meadows, and shorelines while foraging on newly emergent plants, carrion, and intertidal infauna such as clams. During the summer and early fall, brown bears congregate along coastal streams to feed on salmon and other spawning fish. The salmon runs are especially important to the Kodiak, Alaska Peninsula, and McNeil River brown bears. The runs are available from late June to mid-December on Kodiak Island. Female brown bears on the Alaska Peninsula generally are most productive between 9 and 16 years of age, and litters of three cubs are more common there than in other areas; litters of four cubs are known to occur only on Kodiak Island and the Alaska Peninsula (MMS 2003).

3.5.8.3 Sitka Black-Tailed Deer

Sitka black-tailed deer are found on Kodiak, Afognak, and Raspberry islands. The beaches and coastal areas are the primary winter range of this species. Between 1924 and 1934, a total of 25 Sitka black-tailed deer were translocated on Kodiak and Long islands. The deer population expanded into unoccupied habitat, and by the 1960s, deer were dispersed throughout Kodiak, Afognak, and adjacent islands. The population suffered declines due to severe winter snow conditions during the late 1960s and early 1970s.

The population peaked at more than 100,000 deer in the mid-1980s and suffered its greatest decline due to severe winter conditions in 1997–1998. The current population is estimated at 40,000 deer, and the annual harvest is 8,000. During the winter, deer concentrate on the outer capes along the coast, where they forage on kelp. During severe winters, the beach habitats sometimes provide most of the available food (MMS 2003).

3.6 THREATENED AND ENDANGERED SPECIES

Section 7 of the Endangered Species Act (ESA) requires federal agencies to conserve endangered and threatened species. It also requires all federal agencies to consult with the NMFS or the U.S. Fish and Wildlife Service (USFWS) if they determine that any action they fund, authorize, or carry out might affect a listed species or designated critical habitat. Table 3-23 lists the endangered, threatened, and candidate species that might be present near the proposed project area, their current ESA-listing status, and the final rule notice published in the *Federal Register* for each species. Table 3-24 provides the *Federal Register* final rule notice for critical habitat for these species.

Table 3-23. Summary of Species Listed under ESA That Might Occur in Cook Inlet

Species	Population/DPS[a] /ESU[b]	Present Status	Federal Register (FR) Notice	
Fish				
Chinook salmon (*Oncorhynchus tshawytscha*)	Snake River Fall Run	Threatened	57 FR 14653	04/22/92
	Snake River Spring/Summer Run	Threatened	57 FR 14653	04/22/92
Sockeye salmon (*Oncorhynchus nerka*)	Snake River	Endangered	56 FR 58619	11/20/91
Birds				
Short-tailed albatross *(Diomedea albatrus)*	N/D	Endangered	65 FR 46643	07/31/00
Steller's eider *(Polysticta stelleri)*	N/D	Threatened	62 FR 31748	06/11/97
Marine Mammals				
Northern right whale *(Balaena glacialis)*	North Pacific	Endangered	35 FR 8491	06/02/70
Blue whale *(Balaenoptera musculus)*	North Pacific	Endangered	35 FR 8491	06/02/70
Bowhead whale *(Balaena mysticetus)*	Western Arctic	Endangered	35 FR 8491	06/02/70
Fin whale *(Balaenoptera psysalus)*	Northeast Pacific	Endangered	35 FR 8491	06/02/70
Humpback whale *(Magaptera novaeangliae)*	Western and Central North Pacific	Endangered	35 FR 8491	06/02/70
Sei whale *(Balenoptera borealis)*	North Pacific	Endangered	35 FR 8491	06/02/70
Sperm whale *(Physeter macrocephalus)*	North Pacific	Endangered	35 FR 8491	06/02/70
Steller sea lion *(Emuetopias jubatus)*	Western Stock	Endangered	62 FR 24345	05/05/97
Steller sea lion	Eastern Stock	Threatened	55 FR 49203	11/26/90
Northern sea otter *(Enhydra lutris)*	Southwest Alaska	Threatened	70 FR 46366	08/09/05
Beluga whale *(Delphinapterus leucas)*	Cook Inlet Stock	Candidate	N/D	N/D

Sources: USEPA (2004); northern sea otter: USFWS (2005)
[a] DPS: Distinct Population Segment
[b] ESU: Evolutionarily Significant Unit
N/D = Not determined.

Table 3-24. Critical Habitat Designations for ESA-Listed Species That Might Occur in Cook Inlet

Species	Population/DPS[a] /ESU[b]	Present Status	Federal Register (FR) Notice	
Fish				
Chinook salmon (*Oncorhynchus tshawytscha*)	Snake River Fall Run	Threatened	57 FR 14653	04/22/92
	Snake River Spring/Summer Run	Threatened	57 FR 14653	04/22/92
Sockeye salmon (*Oncorhynchus nerka*)	Snake River	Endangered	56 FR 58619	11/20/91
Birds				
Short-tailed albatross *(Diomedea albatrus)*	Population	Endangered	Not Designated	---
Steller's eider *(Polysticta stelleri*)	Population	Threatened	62 FR 31748	06/11/97
Marine Mammals				
Blue whale *(Balaenoptera musculus)*	North Pacific	Endangered	Not Designated	---
Bowhead whale *(Balaena mysticetus)*	Western Arctic	Endangered	Not Designated	---
Fin whale *(Balaenoptera psysalus)*	Northeast Pacific	Endangered	Not Designated	---
Humpback whale *(Magaptera novaeangliae)*	Western and Central North Pacific	Endangered	Not Designated	---
Northern right whale *(Balaena glacialis)*	North Pacific	Endangered	64 FR 10451	03/23/99
Sei whale *(Balenoptera borealis)*	North Pacific	Endangered	Not Designated	---
Sperm whale *(Physeter macrocephalus)*	North Pacific	Endangered	Not Designated	---
Steller sea lion *(Emuetopias jubatus)*	Western Stock	Endangered	62 FR 24345	05/05/97
Steller sea lion	Eastern Stock	Threatened	55 FR 49203	08/27/93
Northern sea otter *(Enhydra lutris)*	Southwest Alaska	Threatened	70 FR 46366	08/09/05
Beluga whale *(Delphinapterus leucas)*	Cook Inlet Stock	Candidate	Not Designated	---

Source: USEPA (2004); northern sea otter: USFWS (2005).
[a] DPS: Distinct Population Segment
[b] ESU: Evolutionarily Significant Unit

3.6.1 Fish

3.6.1.1 Snake River Fall Chinook Salmon

Chinook salmon are anadromous and semelparous meaning that as adults, they migrate from a marine environment into the fresh water streams and rivers of their birth (anadromous) where they spawn and die (semelparous). Seasonal runs (i.e., spring, summer, fall, or winter) have been identified on the basis of when adult chinook salmon enter fresh water to begin their spawning migration (Tetra Tech 2005). Because genetic analyses indicate that fall-run chinook salmon in the Snake River are a distinct evolutionarily significant unit (ESU) from the spring/summer-run in the Snake River Basin (Waples et al. 1991), Snake River fall-run chinook salmon are considered separately. NMFS clarified the status of both ESUs as threatened in 1992 (Tetra Tech 2005).

Two distinct races have evolved among chinook salmon. The stream-type race of chinook salmon, is found most commonly in headwater streams. Steam-type chinook salmon have a longer fresh water residency, and demonstrate extensive offshore migrations into the North Pacific before returning to their natal streams in the spring or summer months (NMFS 1998a; Healy 1991). The ocean-type chinook, including the Snake River fall-run chinook salmon ESU are commonly found in coastal streams in North America. Ocean-type chinook migrate to sea where they tend to spend their ocean life in coastal waters within about 1,000 kilometers (621 miles) from their natal river (NMFS 1998a; Healy 1991). Ocean-type chinook salmon return to their natal streams or rivers in spring, winter, fall, summer, and late-fall runs, but summer and fall runs predominate (Tetra Tech 2005). The difference between these life history types is also physical, with both genetic and morphological foundations (NMFS 1998a).

Almost all historical Snake River fall-run chinook salmon spawning habitat in the Snake River Basin has been blocked by the Hells Canyon Dam complex; other habitat blockages have also occurred in Columbia River tributaries. The ESU's range has also been affected by agricultural water withdrawals, grazing, and vegetation management within the Columbia and Snake River Basins. The continued straying by nonnative hatchery fish into natural production areas is an additional source of risk (Tetra Tech 2005).

The historical population of Snake River fall-run chinook salmon is difficult to estimate. Irving and Bjornn (1981) estimated a population of 72,000 for the period of 1938 to 1949 that declined to 29,000 during the 1950s (Tetra Tech 2005). Numbers declined further following completion of the Hells Canyon Dam complex. The Snake River component of the fall-run chinook has been increasing during the past few years as a result of hatchery and supplementation efforts in the Snake and Clearwater River Basins. In 2002, more than 15,200 fall-run chinook were counted past the two lower dams on the Snake River, with about 12,400 counted above Lower Granite Dam. These adult returns are about triple the 10-year average at these Snake River projects (FPC 2003). For the Snake River fall-run chinook salmon ESU, NOAA Fisheries estimates that the median population growth rate (lambda) over a base period from 1980 through 1998 ranges from 0.94 to 0.86. The decrease in growth rate reflects the increased effectiveness of hatchery fish spawning in the wild increases compared with that of fish of wild origin (McClure et al. 2000).

The critical habitat for the Snake River fall chinook salmon was listed on December 28, 1993 (NMFS 1993) and modified on March 9, 1998, (NMFS 1998a) to include the Deschutes River in Oregon. The designated critical habitat does not include any waters within the state of Alaska. It does include all river reaches accessible to chinook salmon in the Columbia River from The Dalles Dam upstream to the confluence with the Snake River in Washington (inclusive). Critical habitat in the Snake River includes its tributaries in Idaho, Oregon, and Washington (exclusive of the upper Grande Ronde River and the Wallowa River in Oregon, the Clearwater River above its confluence with Lolo Creek in Idaho, and the Salmon River upstream of its confluence with French Creek in Idaho). Also included are river reaches and estuarine areas in the Columbia River from a straight line connecting the west end of the Clatsop jetty (south jetty, Oregon side) and the west end of the Peacock jetty (north jetty, Washington side) upstream to The Dalles Dam (Tetra Tech 2005). Areas above specific dams or above longstanding, naturally impassable barriers (e.g., natural waterfalls in existence for at least several hundred years) are excluded (NMFS 1998a).

3.6.1.2 Snake River Spring/Summer Chinook Salmon

Recent trends in redd counts in major tributaries of the Snake River indicate that many subpopulations could be at critically low levels. Subpopulations in the Grande Ronde River, Middle Fork Salmon River, and Upper Salmon River Basins are at especially high risk. Both demographic and genetic risks would be of concern for such subpopulations, and in some cases, habitat may be so sparsely populated that adults have difficulty finding mates. NOAA Fisheries estimates that the median population growth rate (lambda) over a base period from 1980 through 1998 ranges from 0.96 to 0.80, decreasing as the effectiveness of hatchery fish spawning in the wild increases compared with the effectiveness of fish of wild origin (McClure et al. 2000). In 2002, the fish count at Lower Granite Dam was 75,025, more than double the 10-year average. Estimated hatchery chinook at Lower Granite Dam accounted for a minimum of 69.7 percent of the run (Tetra Tech 2005). The spring chinook count in the Snake River was at the all-time low of about 1,500 as recently as 1995, but in 2001 and 2002, both hatchery and wild/natural returns to the Snake River increased (FPC 2003).

The critical habitat for the Snake River spring/summer chinook salmon was listed in 1993 (NMFS 1993). The designated habitat consists of river reaches of the Columbia, Snake, and Salmon Rivers, and all tributaries of the Snake and Salmon Rivers (except the Clearwater River) presently or historically accessible to Snake River spring/summer chinook salmon (except reaches above impassable natural falls and Hells Canyon Dam) (Tetra Tech 2005).

3.6.1.3 Sockeye Salmon

Snake River sockeye salmon returns to Redfish Lake since at least 1985, when the Idaho Department of Fish and Game began operating a temporary weir below the lake, have been extremely small (1 to 29 adults counted per year). Snake River sockeye salmon have a very limited distribution relative to critical spawning and rearing habitat. Redfish Lake represents only one of the five Stanley Basin lakes historically occupied by Snake River sockeye salmon. NMFS proposed an interim recovery level of 2,000 adult Snake River sockeye salmon in Redfish Lake and two other lakes in the Snake River Basin (NMFS 1995). Because only 16 wild and 264 hatchery-produced adult sockeye returned to the Stanley River Basin between 1990 and 2000, NMFS considers the risk of extinction of this ESU to be very high (Tetra Tech 2005). In 2002, 52 adult sockeye were counted at Lower Granite Dam (FPC 2003). As of September 23, 2003, 12 sockeye salmon have been counted at Lower Granite Dam on the Snake River (USACE 2003).

Historically, the largest numbers of Snake River sockeye salmon returned to headwaters of the Payette River, where 75,000 were taken one year by a single fishing operation in Big Payette Lake. During the early 1880s, returns of Snake River sockeye salmon to the headwaters of the Grande Ronde river in Oregon (Walleye Lake) were estimated between 24,000 and 30,000 at a minimum (Cramer 1990). During the 1950s and 1960s, adult returns to Redfish Lake numbered more than 4,000 fish (Tetra Tech 2005).

The critical habitat for the Snake River sockeye salmon was designated on December 28, 1993 (NMFS 1993). The designated habitat consists of river reaches of the Columbia, Snake, and Salmon Rivers, Alturas Lake Creek, Valley Creek, and Stanley, Redfish, Yellow Belly, Pettit, and Alturas Lakes (including their inlet and outlet creeks) (Tetra Tech 2005).

3.6.2 Birds

3.6.2.1 Short-tailed Albatross

Geographic Range and Spatial Distribution. The short-tailed albatross once ranged throughout most of the North Pacific Ocean and Bering Sea. Breeding colonies of the short-tailed albatross are currently known on two islands in the western North Pacific and East China Sea. Torishima Island, the main nesting island, is controlled by Japan and is protected as a national monument. Ownership of the second island, Minami-Kojima, is disputed. This island is claimed by Japan and China (by both the Republic of China on Taiwan and the People's Republic of China). Due to an error, the USFWS mistakenly designated this species as endangered throughout its range except in the United States. In November 1998, the USFWS announced a proposed rule to include the United States in the protected range of this species. Sighting data indicate that neither Cook Inlet nor the Shelikof Strait is part of the typical range of this species (MMS 2003)

Critical Habitat. Critical habitat has not been designated for this species.

Historical Information. During the late 1800s and early 1900s, feather hunters killed an estimated 5 million short-tailed albatrosses. In the 1930s, volcanic eruptions damaged the nesting habitat on the last nesting island in Japan. However, by this time, protection measures were already in place in Asia and the animals have begun to recover (ADFG 2003b).

Life History. These birds mate for life, returning to the same nest sites in the breeding colony for many years. Currently there are only two known breeding colonies: one on Torishima Island in the Izu Shoto Island group about 580 kilometers south of Japan and the other on Minami-Kojima Island in the Senkaku Retto, southwestern Ryukyu Islands about 270 kilometers northeast of Taiwan (NatureServe 2003). Short-tailed albatross nesting occurs on flat or sloped sites, with sparse or full vegetation, on isolated windswept offshore islands. Five months after hatching, chicks leave the nest to wander across the North Pacific. Adults spend their non-breeding seasons at sea as well, feeding on squid, fish, flying fish eggs, and shrimp and other crustaceans (ADFG 2003b).

Population Trends and Risks. Only one primary breeding colony exists on Torishima Island in Taiwan. Because of the significance of this breeding colony, the threat of habitat destruction by volcanic eruptions poses the most severe danger to the existence of the species. The population on Torishima Island is now growing at an annual rate of 7.8 percent. In 1987 to 1992, the global population was about 600 birds, with about 125 breeding pairs; by 2001, the population was about 1,500 birds, with about 680 breeding individuals (NatureServe 2003). Other factors may also hinder the recovery of the short-tailed albatross including damage or injury related to oil contamination, consumption of plastic debris in marine waters, and accidental entanglement in fishing gear, especially baited longline hooks. Natural environmental threats, small population size, and the small number of breeding colonies continue to put the worldwide population of short-tailed albatrosses in danger of extinction. Other threats such as pollution or entanglement in fishing gear do not represent significant threats; in combination with a catastrophic event, however, they could threaten the future survival of this species (63 *FR* 58692, November 2, 1998).

3.6.2.2 Steller's Eider

Geographic Boundaries and Spatial Distribution. The USFWS has listed the Steller's eider Alaskan breeding population as threatened. Steller's eiders are the smallest of the four eider species. The species' current breeding range in Alaska is primarily confined to the Arctic coastal plain between Wainwright and Prudhoe Bay, with a notable concentration near Barrow (USFWS 2002a).

Steller's eiders are not reported to nest in any locations within or near the proposed lease-sale area. However, a relatively small number of Steller's eiders (approximately 100) also have been observed to remain in Kachemak Bay during the summer (MMS 2003). Available evidence indicates wintering Steller's eiders are widely scattered throughout the very large area, including in shallow, nearshore marine areas near, and less likely within, the Cook Inlet lease-sale area. These areas include parts of nearshore areas of eastern Lower Cook Inlet, Kachemak Bay, Kamishak Bay, and the Kodiak Archipelago (MMS 2003).

While the number of Steller's eiders observed has varied considerably and data currently are insufficient to rigorously estimate abundance, Steller's eiders are present in relative low abundance and density in areas near the lease-sale area compared with areas such as Nelson and Izembek lagoons. The USFWS (65 *FR* 13262, March 13, 2000) speculated that when wintering birds from the north side of the Alaska Peninsula are excluded from protected waters by ice, they may be forced to "…less preferred feeding areas on the south side of the Alaska Peninsula and up to lower Cook Inlet" (65 *FR* 13271, March 13, 2000). The USFWS concluded (66 *FR* 8863, February 2, 2001) that neither the Kachemak Bay/Ninilchik, Kodiak Archipelago, nor the south side of the Alaska Peninsula (marine wintering areas that could conceivably be affected by the proposed action) "…regularly contain greater than 5,000 individuals…," and "…that the available information does not demonstrate that any of these areas are essential for the recovery of the Alaska-breeding population of the Steller's eider" (MMS 2003).

Critical Habitat. According to the *Federal Register*, the critical habitat designated for the Steller's eider includes breeding habitat on the Yukon-Kuskokwim Delta, and four units in southwest Alaska marine waters, including the Kuskokwim Shoals in northwest Kuskokwim Bay, Seal Islands, Nelson Lagoon, and Izembek Lagoon on the north side of the Alaska Peninsula.

Historical Information. The Alaska breeding population (one of three) historically nested in western and northern Alaska. In western Alaska, Steller's eiders were formerly considered locally common in portions of the Yukon-Kuskokwim Delta and were recorded nesting on Saint Lawrence Island, Seward Peninsula, Alaska Peninsula, and the Aleutian Islands. Today, however, they are extremely scarce on the Yukon-Kuskokwim Delta and have not been found breeding elsewhere in western Alaska in several decades.

Life History. After nesting, Alaska's Steller's eiders migrate south in the fall. These ducks move into the nearshore marine waters of southwest Alaska where they mix with the much more numerous Russian Pacific population. Adults undergo a flightless molt in autumn. Although some remain in molting areas throughout winter, others disperse into the coastal waters of the eastern Aleutian Islands, the south side of the Alaska Peninsula, the Kodiak Archipelago, and southern Cook Inlet. During spring migration, Steller's eiders concentrate in Kuskokwim and Bristol bays to await the retreat of sea ice and opening of overwater migratory routes.

Steller's eiders are diving ducks that spend most of the year in shallow, nearshore marine waters. Molting and wintering flocks congregate in protected lagoons and bays, as well as along rocky headlands and islets. They feed by diving and dabbling for mollusks and crustaceans in shallow water. In the summer, they nest in tundra adjacent to small ponds or within drained lake basins. During the breeding season, they feed on aquatic insects and plants in fresh water ponds and streams (USFWS 2002a). In the winter, Steller's eiders consume the common blue mussel and the sand-hopper (*Anisogammarus pugettensis*). During the summer breeding season, they eat aquatic insects and plants, along with crustaceans and mollusks (USFWS 2002a).

Population Trends and Risks. Population sizes are imprecisely known. The threatened Alaska-breeding population is thought to include hundreds or low thousands on the arctic coastal plain and possibly tens or hundreds on the Yukon-Kuskokwim Delta (USFWS 2002a). Steller's eiders are vulnerable to human disturbance because their primary nesting habitat is close to Barrow, the largest village on the Alaska Arctic coastal plain. Human and industrial activities in this large native village near gas fields could lead to nesting habitat loss and disturbance to nesting birds. These eiders generally winter in largely undisturbed areas within National Wildlife Refuges, State Game Refuges, or State Critical Habitat. A serious decline in numbers has occurred for this species, but scientists have not determined a cause. Causes of the population decline might include lead poisoning from ingesting spent lead shot or predation by ravens, foxes, and gulls on the breeding grounds where populations of these predators are enhanced by food and shelter provided by human activities and garbage dumps. Shipping and fishing pose the risk of oil spills and disturbance of feeding flocks in marine waters. Other possible threats include marine contaminants and changes in the Bering Sea ecosystem affecting food availability, specifically interspecific competition on the wintering range and restructuring of benthic communities by feeding pressure from sea otters (USEPA 2002; USFWS 2002a). Scientists have not demonstrated that any of these factors have directly affected Steller's eiders in Alaska; however, this species' small population size and restricted breeding area warrant further investigation and protection from disturbances (USEPA 2002a).

3.6.3 Marine Mammals

3.6.3.1 Northern Right Whale

Geographic Boundaries and Spatial Distribution. Northern right whales inhabit temperate and subpolar waters of the North Pacific (USEPA 2002). Right whales have no dorsal fin or ventral grooves, but do possess a noticeable series of horny growths called “callosities.” This endangered species also shares the genus *Balaena* with another baleen whale, the bowhead. Although the ranges of the bowhead and right whales overlap in the North Pacific, these species do not usually occupy the areas at the same time (USEPA 2002).

Three major populations of right whales exist: the North Atlantic, the North Pacific, and Southern oceans. Northern right whales inhabit both the North Atlantic and North Pacific (USEPA 2002). In the North Pacific, right whales grow to larger sizes than right whales from other areas. These animals usually feed below the surface and near the bottom. Right whales belong to the suborder Mysticeti, as do all other baleen whales. Mysticetes do not develop teeth but instead develop a baleen, a comblike structure composed of a dense fringe of blade-shaped, horny plates that hangs down from the roof of the mouth and acts as a filter. As specialized feeders, right whales can preferentially take small, planktonic animals like copepods and euphausiids from the fine bristles of their baleen (USEPA 2002).

Critical Habitat. Critical habitat for the northern right whale has been designated only in the Atlantic Ocean.

Historical Information. The name of the right whale originated with early European whalers, who deemed these whales the “right” whales to catch because they swim slowly, float when dead, and provide a good return in terms of both oil and whalebone. Whalers pursued the right whale first as a part of the massive whaling efforts that have occurred since the 10th century. By the beginning of this century, whaling had reduced population levels significantly. In the 19th century alone, whalers killed 100,000 animals (USEPA 2002). International regulations have protected the whales from hunting since 1935, but some illegal hunting and research kills have occurred since that date.

Life History. Generally, the animals spend the summer feeding in the north then migrate south to breed in the winter, although few winter records exist. All the identified calving grounds are near the coast, often in shallow bays, but insufficient information exists to determine that right whales calve exclusively in such waters.

Population Trends and Risks. On the basis of sightings data reported in 1973, the estimated total population in the North Pacific is between 100 and 200 animals, although a reliable estimate of abundance for the North Pacific right whale stock is currently unavailable (NMFS 2002a). Scientists consider these whales the most endangered of all whale species. Collisions with ships represent the single largest cause of right whale mortality associated with humans. Entanglements in fishing gear have also contributed to the species’ decline (USEPA 2002).

3.6.3.2 Bowhead Whale

This large, stocky whale has no throat grooves and shares the same genus as both the northern and southern right whales. Its large head makes up about one-third of the total length of the animal and contains upward, arching jaws that create the "bowed" head appearance. Bowhead whales feed both at midwater ranges and at the sea bottom. Their prey includes copepods, steropods, mysids, euphausiids, and some benthic prey (USEPA 2002).

Geographic Boundaries and Spatial Distribution. The majority of these whales inhabit areas around Alaska as part of the Western Arctic stock. Five populations existed historically; however, one population might be extinct and three others exist only in low numbers (NMFS 2002b). Bowhead whales live wholly in Arctic or subarctic waters and have adapted to living along the pack ice with little tendency for migration.

Critical Habitat. Critical habitat has not been designated for the bowhead whale.

Historical Information. Native hunting of bowhead whales began over 1,000 years ago, but the arrival of the Europeans in the late 1800s precipitated the near elimination of the eastern Arctic bowhead whales (USEPA 2002). Protection from hunting now extends all over the world with the exception of Alaska. Alaskan tribes kill fewer than 50 animals per year as a limited subsistence take (USEPA 2002).

Life History. The western Arctic bowhead whale has the best-known movements (USEPA 2002). This endangered species winters in the southwestern Bering Sea, near the ice edge, and spends summers feeding and calving in the Beaufort Sea off the coast of Canada and Alaska. When the pack ice breaks up in the spring, these whales migrate from the Bering Sea through the Bering Strait into the Chukchi Sea and eventually into the Beaufort Sea (USEPA 2002). Calving and breeding take place in open water near the edge of the pack ice (USEPA 2002).

Population Trends and Risks. Acoustic data from 1993 have resulted in an estimate of 8,200 animals, with a 95 percent confidence interval of 7,200 to 9,400, and is considered the best available abundance estimate for the western Arctic stock (NMFS 2002b). The minimum population estimate, according to the population estimate of 8,200 for the western Arctic stock of bowhead whales is 7,738 (NMFS 2002b). Subsistence takes by Eskimos have been regulated by a quota system under the authority of the International Whaling Commission since 1977. Alaska Native subsistence hunters take approximately 0.1 to 0.5 percent of the population per annum. Under this quota, the number of kills has ranged between 14 and 72 per year (NMFS 2002b). This harvest poses little threat to the existence of the species, and the population has continued to increase during the period of this hunt (NMFS 2002b). Other threats may include offshore oil and gas development, human disturbance, and aquatic pollution (NMFS 2002b).

3.6.3.3 North Pacific Sei Whale

Geographic Boundaries and Spatial Distribution. In the North Pacific, the endangered sei whale occurs mainly south of the Aleutian Islands. Some reports document sightings by Japanese scientists, indicating that sei whales may occur in the northern and western Bering Sea, but these data have not been confirmed and must be considered suspect. Sei whales do occur all across the temperate North Pacific north of 40º N. Their southern range extends as far south as Baja California, Mexico, in the eastern Pacific, and to Japan and Korea in the west (Reeves et al. 1998a). Because sei whales tend to occur in open ocean, it is unlikely that they will occur within the project area, especially in the area to the north of Anchor Point (MMS 2003). No sei whales were observed during a 1994 ship survey of the area south of Unimak Pass to the end of Kodiak Island. In 2001, sei whales were observed just outside of Uyak Bay (MMS 2003).

Critical Habitat. Critical habitat has not been designated for the sei whale.

Historical Information. Of any threat to this species, whaling has claimed the largest proportion of sei whales. Whalers took several hundred sei whales each year from shore stations in Japan and Korea between 1910 and the start of World War II. Heavy exploitation by pelagic whalers began in the early 1960s. The reported take of sei whales in the North Pacific by commercial whalers totaled 61,500 for the years between 1947 and 1987.

Life History. Only the largest adults venture into true polar waters (USEPA 2002). This pelagic species generally does not inhabit inshore and coastal waters. Sei whales mainly feed on copepods and euphausiids; however, whales in the North Pacific also prey on pelagic squid and fish up to the size of an adult mackerel (Reeves et al. 1998a). Essentially, the species will take any swarming or shoaling prey species in abundance locally.

Population Trends and Risks. There are no data on trends in sei whale abundance in the eastern North Pacific waters. Although the population in the North Pacific is expected to have grown since being given protected status in 1976, the possible effects of continued unauthorized take and incidental ship strikes and gill-net mortality make this uncertain (NMFS 2000). Current threats may affect sei whales, but do not result in significant takes compared with decimation caused by whaling. These threats may include collisions with ships, disturbance from vessels, entanglement in fishing gear, and aquatic pollution (Reeves et al. 1998a).

3.6.3.4 Blue Whale

Geographic Boundaries and Spatial Distribution. Blue whales inhabit every ocean of the world, from the equator to the poles, occurring primarily in the open ocean. The largest animal that ever lived, this endangered species migrates annually to polar waters to feed in the summer, then returns to temperate and tropical waters for winter breeding. However, observers have rarely spotted this pelagic species near the coast, except in polar regions. There are no current distribution data for blue whales in the western North Pacific Ocean (MMS 2003).

Despite the extreme rarity of sightings of blue whales in the Gulf of Alaska over the past 15 years, blue whale vocalization data collected over the past 2 years using passive acoustic recorders consistently indicate that blue whales are present in the Gulf of Alaska region between July and December (MMS 2003).

Critical Habitat. Critical habitat has not been designated for the blue whale.

Historical Information. The introduction of steam power in the second half of the 19th century allowed boats to overtake the large, fast-swimming blue whales, but not until the development of the deck-mounted harpoon cannons did killing and securing of blue whales occur on an industrial scale. Blue whales gained protection under the International Convention for the Regulation of Whaling in 1966, however, Russian whalers continued to take whales illegally in both the northern and southern Pacific.

Life History. Near the poles, blue whales frequently follow the retreating ice edge as summer progresses. Blue whales faithfully return to feeding areas, but we know little about the breeding grounds of this animal. These animals appear to practice more selective behavior in feeding than other rorquals (baleen whales that possess external throat grooves that expand during gulp-feeding) and specialize in plankton feeding, particularly swarming euphausiids in the Antarctic. They preferentially take euphausiids even with abundant shoaling fish in the area. Copepods and decapods make up a small and rarely observed portion of the blue whale's diet (USEPA 2002).

Population Trends and Risks. The International Whaling Commission has formally considered only one management stock for blue whales in the North Pacific, but now this ocean is thought to include more than one population, possibly as many as five (Carretta et al. 2002; Reeves et al. 1998b). It was hypothesized that blue whales from Baja California migrated far offshore to feed in the eastern Aleutians or Gulf of Alaska and returned to feed in California waters; however, more recently it has been concluded that the California population is separate from the Gulf of Alaska population. Recently, blue whale feeding aggregations have not been found in Alaska despite several surveys (Carretta et al. 2002).

Whaling has caused the largest reductions in the population of this species, but other factors may also contribute to its decline or may prevent the population's recovery. These factors include collisions with ships, disturbance by commercial and recreational vessels, entanglement in fishing gear, habitat degradation, and aquatic pollution. Little evidence exists to support the conclusion that any of these factors caused a serious decline in the blue whale population, but these factors may prevent the recovery of the species (Reeves et al. 1998b).

3.6.3.5 Fin Whale

Geographic Boundaries and Spatial Distribution. Fin whales are baleen whales found in offshore waters throughout the North Pacific from Baja California to the Chukchi Sea. High concentrations of these endangered animals inhabit the northern Gulf of Alaska and southeastern Bering Sea in the summer (Reeves et al. 1998a). Observers have rarely reported sightings of this pelagic species in inshore coastal waters (USEPA 2002). With a complex migratory behavior, these whales can occur in any season at many different latitudes (USEPA 2002). Even though they may easily enter polar waters, these whales are not commonly observed close to the polar pack ice, unlike blue whales (USEPA 2002). A fin whale's movements may depend on the whale's age or reproductive status as well as the stock to which it belongs. The NMFS recognizes three Pacific stocks in U.S. waters: Alaska, California/Washington/ Oregon, and Hawaii. Where fin whales breed is not known, but research indicates that they are primarily solitary animals. They might infrequently congregate in groups of up to 15. However, the low-frequency vocalizations made by whales can travel some distance, making it difficult to determine which whales associate with one another (USEPA 2002). In the North Pacific, fin whales prefer euphausiid shrimp and large copepods as prey, but they also consume schooling fish such as herring, walleye, pollock, and capelin (Reeves et al. 1998a). Current information indicates that these whales feed seasonally (USEPA 2002).

Fin whales regularly inhabit areas near the lease-sale area including Shelikof Strait, bays on Kodiak Island (especially on the west side), and the Gulf of Alaska. Some or all of these areas are feeding areas for fin whales. Information indicates that the distribution and relative abundance of fin whales in these areas vary seasonally, but there is documented use of parts of the Kodiak Archipelago/Shelikof Strait region in most months (MMS 2003).

Critical Habitat. Critical habitat has not been designated for the fin whale.

Historical Information. After the commercial extinction of the blue whale, whalers turned their attention to fin whales. Whalers took almost 500,000 whales between the 1930s and 1960s, mostly in the Antarctic. Now that this species enjoys worldwide protection from whaling, scientists estimate the number of fin whales to total 60,000–100,000 worldwide (USEPA 2002).

Life History. Fin whales have a complex migratory behavior, and they can occur in any season at many different latitudes (USEPA 2002). A fin whale's movements may depend on the whale's age or reproductive status as well as the stock to which it belongs.

Population Trends and Risks. Reliable information on trends in abundance for the northeast Pacific stock of fin whales is currently unavailable, and there is no indication whether recovery of this stock has taken place or is taking place (NMFS 2001a). Currently, the largest threats to fin whales include development and habitat destruction, entanglement in fishing gear, and a renewed interest in whaling by several countries (USEPA 2002).

3.6.3.6 Humpback Whale

Humpback whales belong to the rorqual, or Balaenopteridae, family of the baleen whales in the suborder Mysticeti. One of the most distinguishing characteristics of humpback whales is their long flippers, approximately one-third their body length. The males of the species also produce the longest songs in the animal world (USEPA 2002).

Geographic Boundaries and Spatial Distribution. Surveys indicate that humpbacks occupy habitats around the world, with three major, distinct populations: the North Atlantic, the North Pacific, and the Southern oceans. These three populations do not interbreed. Humpbacks generally feed for 6–9 months of the year on their feeding grounds in Arctic and Antarctic waters. The animals then fast and live off their fat layer for the winter period while in the tropical breeding grounds (USEPA 2002).

The herd of humpback whales that typically occupies southeastern Alaska waters also migrates to Hawaii and Mexico in the winter months for breeding. This herd does appear to remain geographically separated from the other Alaskan herds in Prince William Sound and on the western Gulf of Alaska coastline (USEPA 2002). The southeast Alaskan herd makes up approximately 17 to 25 percent of the North Pacific population and generally occupies this area from summer to fall (USEPA 2002). The rest of the Alaskan humpback whale population occupies areas from Japan to the Kodiak Archipelago, including the Bering Sea and Aleutian Islands (USEPA 2002). Humpbacks eat primarily small schooling fish such as herring, capelin, pollock, and sand lance. They also commonly consume euphausiid shrimp (USEPA 2002).

In the summer, humpback whales regularly are present and feeding in areas near and within the Cook Inlet lease-sale area, including Shelikof Strait, bays of Kodiak Island, and the Barren Islands, in addition to the Gulf of Alaska adjacent to the southeast side of Kodiak Island (especially Albatross Banks), the south sides of the Kenai and Alaska peninsulas, and south of the Aleutian Islands. There is some evidence of a discrete feeding aggregation of humpbacks in the Kodiak Island region. Humpbacks also may be present in some of these areas throughout the autumn. Within the proposed lease-sale area, large numbers of humpbacks have been observed in late spring and early summer feeding near the Barren Islands. Humpbacks have also been observed feeding near the Kenai Peninsula north and east of Elizabeth Island (MMS 2003).

Critical Habitat. Critical habitat has not been designated for the humpback whale.

Historical Information. Whaling took large numbers of humpbacks from the late 1800s through the early 20th century. Even though the International Whaling Commission provided protection to the species in the early 1960s, the Soviet Union has recently revealed massive illegal and unreported kills that occurred up until 1970 in the southern oceans.

Life History. Although humpback whales can be seen in Alaska at any time of the year, most migrate during the fall to temperate or tropical wintering areas where reproduction and calving occur. During the spring, humpback whales migrate back to Alaska where food sources are abundant. While in Alaska, most humpbacks concentrate in southeast Alaska, Prince William Sound, the area near Kodiak and the Barren Islands, the area between Semidi and Shumagin Islands, and the eastern Aleutian Islands and southern Bering Sea (USEPA 2002).

Population Trends and Risks. The current abundance estimate of humpback whales in the North Pacific is based on data collected by nine independent research groups that conducted photo-identification studies of humpback whales in the three wintering areas (Mexico, Hawaii, and Japan). Current estimates give the population size of the North Pacific stock at 4,005 animals (NMFS 2001b). Under current protection provided by the International Whaling Commission and individual countries, this species continues to recover. Although data support the conclusion of an increasing population size for the central North Pacific stock, it is not possible to assess the rate of increase (NMFS 2001b). The greatest threats to their survival are entanglement in fishing gear, collisions with ship traffic, and pollution of their coastal habitat by human settlements (USEPA 2002).

3.6.3.7 Sperm Whales

Geographic Boundaries and Spatial Distribution. The largest of all the toothed whales, sperm whales occur in all the world's oceans, from the equator to polar waters. They rarely enter semi-enclosed areas, but instead prefer oceanic habitat (USEPA 2002). These whales also tend to inhabit waters at depths of 180 meters (approximately 600 feet) or more, and only rarely occur in waters less than 90 meters (approximately 300 feet) deep.

Available evidence indicates that mature males are present offshore in the Gulf of Alaska during the summer in unknown abundance, but they are very unlikely to be present in the lease-sale area (MMS 2003).

Critical Habitat. Critical habitat has not been designated for the sperm whale.

Historical Information. Commercial whaling exploited the sperm whale to a large extent; however, the population of sperm whales still numbers almost 2 million animals, about half of which inhabit the North Pacific (USEPA 2002).

Life History. The distribution of sperm whales depends on their food source, suitable conditions for breeding, and the sex and age composition of the group (USEPA 2002). Males generally tolerate a wider range of temperatures and migrate into the higher latitudes, whereas females and juveniles remain in warm oceanic waters year-round. Calving generally occurs in the summer and fall (USEPA 2002).

Sperm whales feed almost exclusively on cephalopods (squid and octopuses), but in a few places, such as Alaska, fish form an important part of the sperm whales' diet. Some of the fish species consumed are rays, sharks, lanternfish, cod, and redfish. Feeding occurs all year, usually at depths below 120 meters (approximately 400 feet) (USEPA 2002).

Population Trends and Risks. A preliminary analysis indicates that there are 102,112 sperm whales in the western North Pacific. In the eastern temperate North Pacific a preliminary estimate indicates 39,200 sperm whales (NMFS 1998b). The number of sperm whales of the North Pacific occurring within Alaska waters is unknown. Because the data used in estimating the abundance of sperm whales in the entire North Pacific are well over 5 years old at this time, and there are no available estimates for numbers of sperm whales in Alaska waters, a reliable estimate of abundance for the North Pacific stock is not available (NMFS 1998b).

Entanglement in fishing gear, especially drift gill nets has recently become a more significant problem. Aquatic pollution might also affect these animals, but evidence to support this conclusion is scarce (USEPA 2002).

3.6.3.8 Beluga Whale (Cook Inlet Stock)

Geographic Boundaries and Spatial Distribution. As a species, beluga whales are circumpolar in distribution, inhabiting subarctic and Arctic waters. In Alaska, the known range of the beluga extends from Yakutat to the Alaska–Canada border in the Beaufort Sea. Available information indicates that beluga populations are variable in their relative mobility. Some populations undertake long seasonal migrations, whereas other populations stay in a relatively small area year-round (MMS 2003).

The Cook Inlet beluga whale is a geographically isolated, genetically differentiated population of beluga whales. At present, at least some members of this population apparently tend to stay much or all of the year in the inlet. Thus, this stock is vulnerable to anthropogenic changes in that area. Cook Inlet belugas prey on a wide variety of marine organisms, including species of fish that enter the inlet from the open ocean.

The known summer distribution of this population apparently has shrunk since the mid-1970s, and sightings in the lower inlet and offshore areas are now rare. Data indicate that population size may have declined by nearly 50 percent between 1994 and 1998 due primarily to a high and unsustainable take by Alaska Native hunters. The stock is now considered ‘depleted’ and, as such, the subsistence hunt is now being regulated. At present, documented zones of high summer use include areas in or near the Susitna Delta, Knik Arm, and Point Possession in the extreme upper inlet (Figure 3-12). In winter, belugas are seen in the central inlet, but the whales are more dispersed than in the summer and sightings are fewer. Belugas can also occur within the proposed Cook Inlet lease-sale area, although recent sightings are rare. Sightings in areas that are “downstream” of the proposed activities are rare at present. Beluga whales have acute hearing, which they can use to echolocate and communicate (MMS 2003).

The strongest influence on the distribution and relative abundance of belugas in Cook Inlet probably is the availability of prey. In summer the belugas congregate in shallow, relatively low salinity and warm areas near river mouths in upper Cook Inlet. These areas have relatively good prey availability and low predator occurrence. Belugas often go into the rivers, such as the Kenai and the Susitna, after fish. Native hunters reported that belugas have ascended the Beluga River to Beluga Lake (MMS 2003).

With respect to winter habitat and other use of areas outside the inlet, it is currently unknown whether this stock migrates seasonally from Cook Inlet and, if so, where it goes. Information from sightings and from the small number of satellite-tagged individuals indicates that at least some individuals stay in the inlet year-round. However, in previous years, belugas presumed to be from the Cook Inlet stock have been observed outside Cook Inlet. It is unknown how many individuals travel to the lower inlet (although if they are there, they are rarely observed) or leave the inlet altogether in most years, or what factors (for example, age, sex, reproductive status, ice conditions) might be associated with winter distribution patterns and the tendency for individuals to stay in or leave the inlet (MMS 2003).

Critical Habitat. Critical habitat has not been designated for the beluga whale.

Historical Information. Information about long-term abundance trends is not available because of the variety and lack of documentation in many of the previous surveys.

Life History. There is little information on the current reproductive characteristics of beluga whales in Cook Inlet. Calving in Cook Inlet may occur from mid-May to mid-July, but Alaska Native hunters report calving to occur from April to August. No calves were observed during aerial surveys in mid-June (MMS 2003). Hunters reported that cows with near-term fetuses have been caught in the Susitna Flats in May. These hunters reported that calving areas include the northern side of Kachemak Bay in April and May, areas off the mouths of the Susitna and Beluga rivers in May, and Chickaloon Bay and Turnagain Arm in the summer (MMS 2003).

Cows generally give birth to a single calf, but Native Alaska hunters occasionally have observed a female with two calves. Native hunters reported that few all white belugas are left in the inlet, and gray cows (assumed to be younger) are having calves. Age of sexual maturity likely is variable, with reports ranging 4–7 years to 10 years for females and 8–9 years for males. Available information indicates that breeding occurs shortly after calving (MMS 2003).

Documented natural sources of mortality in Cook Inlet belugas include stranding and predation. However, little is known about natural causes of death in these whales or typical survival rates. Reports indicate that beluga whales may live for 30 or more years (MMS 2003).

Population Trends and Risks. All available information indicates that the population abundance of beluga whales in Cook Inlet has recently declined, primarily because of high and unsustainable levels of whales take by Alaska Native hunters. The population now is considered to be below the Optimal Sustainable Population. However, there is considerable uncertainty about current population size, past population size, and the carrying capacity of the stock (MMS 2003).

3.6.3.9 Steller Sea Lion (Eastern and Western Stocks)

Geographic Boundaries and Spatial Distribution. The largest of the otariids, Steller sea lions belong to the suborder Pinnipedia and the family Otariidae. They show a marked sexual dimorphism, with adult males larger than adult females. Steller sea lions are polygamous and use traditional territorial sites for breeding and resting. Breeding sites, also known as rookeries, occur on both sides of the North Pacific, but the Gulf of Alaska and Aleutian Islands contain most of the large rookeries. Adults congregate for purposes other than breeding in areas known as haulouts (USEPA 2002). In 1997, the NMFS classified Steller sea lions into two distinct population segments divided by the 144º W latitude. The eastern population segment's habitat includes southeastern Alaska and Admiralty Island. The NMFS has classified the western population segment as endangered and the eastern population segment as threatened (62 *FR* 24345, May 5, 1997). The Steller sea lion population has declined steadily for the past 30 years (USEPA 2002).

The overall range of the Steller sea lion extends from California to northern Japan into the Bering Sea and along the eastern shore of the Kamchatka Peninsula. The geographic center of their distribution is considered to be the Aleutian Islands and the Gulf of Alaska. The center of abundance for the species is considered to extend from Kenai to Kiska Island. The breeding range of this species includes most of the North Pacific Rim from approximately 34° to 60° N latitude, throughout which there are hundreds of Steller sea lion rookeries and haulouts (MMS 2003).

Critical Habitat. Critical habitat for the Steller sea lion was designated on August 27, 1993 (58 *FR* 45269 August 27, 1993) from information available at the time about rookery areas, haulouts, and marine areas required by the species for survival in the wild.

Rookeries are areas used by adult males and females for pupping, nursing, and mating during the mating season (late May to early July). Haulouts are used by both males and females of all size classes but generally are not sites where reproduction occurs. Critical habitat for Steller sea lions includes the following:

- A terrestrial zone that extends 0.9 kilometers (3,000 feet) landward from the baseline or base point of each major rookery and major haulout.
- An air zone that extends 0.9 kilometers (3,000 feet) above the terrestrial zone, measured vertically from sea level.
- An aquatic zone that extends 0.9 kilometers (3,000 feet) seaward in state- and federally managed waters from the baseline or base point of each major haulout in Alaska that is east of 144º W longitude.
- An aquatic zone that extends 37 kilometers (20 nautical miles) seaward in state- and federally managed waters form the baseline or base point of each major rookery and major haulout in Alaska that is west of 144º W longitude.

The critical habitat for Steller sea lions includes two kinds of marine foraging habitat: (1) areas immediately around rookeries and haulouts and (2) three special aquatic foraging areas where large concentrations of important Steller sea lion prey species occur and where Steller sea lions are known to forage (MMS 2003).

The three special Steller sea lion foraging areas are the Shelikof Strait Foraging Area, Bogoslof Foraging Area in the Bering Sea shelf, and Sequam Foraging Area. Of these three areas, only the Shelikof Strait Special Foraging Area is near the proposed multiple lease-sale area (MMS 2003).

The Shelikof Strait Special Foraging Area portion of Steller sea lion critical habitat consists of the area between the Alaska Peninsula and the Tugidak, Sitkinak, Aiaktilik, Kodiak, Raspberry, Afognak, and Shuyak Islands (connected by the shortest lines). It is bounded in the west by a line connecting Cape Kumlik (56º38' longitude/157º26' W latitude) and the southwestern tip of Tugidak Island (56º24' longitude/154º41' W latitude) and bounded in the east by a line connecting Cape Douglas (58º51' N longitude/153º15' W latitude) and the northernmost tip of Shuyak Island (58º37' N longitude/152º22' W latitude). Shelikof Strait was identified in 1980 as a site of extensive winter spawning aggregations of pollock and, from the take of Steller sea lions in the pollock fishery, as an important Steller sea lion foraging site (MMS 2003).

There is designated critical habitat and other habitat considered as critical habitat by the NMFS within the lease-sale area: at Cape Douglas, the Barren Islands, and marine areas adjacent to the southwestern Kenai Peninsula, and at the extreme southern end of Cook Inlet. There is additional critical habitat—including rookeries, haulouts, and marine foraging areas for the western population stock—in areas near the proposed lease-sale area, including Shelikof Strait, and areas along the southern side of the Alaska Peninsula (MMS 2003).

Historical Information. Historically, Steller sea lions were the primary source of food for inhabitants of the Aleutian Islands. Their skins were used to make clothing, boots, and boat coverings. Between 1964 and1972, Steller sea lion pups were commercially harvested for their hides. Since 1972 and the passage of the Marine Mammal Protection Act, there has been little use of the Steller sea lion. However, some are still taken by Alaska Natives for food around Kodiak Island, the Aleutian Islands, and Pribilof Island (USEPA 2002).

Estimates of Steller sea lion historical abundance are crude and not well documented. It is estimated that there were over 300,000 Steller sea lions in the world in the late 1970s. Since then, the Alaskan sea lion population has plummeted to a small fraction of earlier levels. Historically, the Gulf of Alaska and Aleutian Islands contained the largest proportion (74 percent in 1977) of the world population, but by 1989, it dropped to 56 percent (MMS 2003).

Life History. Males establish territories on rookeries in May before females arrive. Females generally give birth to a single pup; twinning is rare. Females are capable of pupping every year but do not always do so. Pups are born during late May to early July. About 2 weeks after giving birth, females breed. During the first week after birth, mothers generally stay with their newborn pups and then begin to go to sea on foraging trips. Observations of maternal attendance patterns of sea lions in southeast Alaska (outside the range of the western population stock) indicate that weaning occurs in early spring (i.e., April–June). Most, but not all, pups wean before their first birthday, but some females nurse offspring for a year or more (MMS 2003).

Data indicate that females become sexually mature at between 3 and 8 years of age and may continue to breed into their early 20s. Females may live as long as 30 years. Data indicate that males reach sexual maturity at about the same range of ages as do females, but they are not successful at holding a breeding territory until they are at least 9 years of age. Males can remain on their territory for up to 7 years, but most are territorial for no more than 3 years. Males typically do not live beyond their mid-teens (MMS 2003).

Steller sea lions spend most of their time at rookeries or haulouts; this is also where most scientific observations are made. Habitat types that typically serve as rookeries or haulouts include rock shelves; ledges; slopes; and boulder, cobble, gravel, and sand beaches. When foraging in marine habitats, Steller sea lions typically occupy surface and midwater ranges in coastal regions. Some animals may also follow prey into river and inlet systems (USEPA 2002).

Pollock and mackerel comprise most of the diet of Steller sea lions, which also frequently consume other small schooling fish such as salmon, herring, and capelin (USEPA 2002). The sea lions generally leave haulouts and rookeries to feed for periods of time varying from hours to months. However, they often return to the same haulout or rookery even after long absences (USEPA 2002).

Population Trends and Risks. At present, the western population stock of Steller sea lions contains about 30,000–35,000 animals, is declining at about 4–5 percent a year, and has an excess (beyond what would be expected at that population size if stable) mortality of about 1,700 animals per year; 50–75 percent of this excess mortality is unexplained. Findings on adult females and young of the year indicate that at present, individuals from the western declining populations are in better condition than those in the increasing eastern population, but information on weaned pups and juveniles is not sufficient to address nutritional impacts on this vulnerable age class. The western population of Steller sea lions is expected to decline at least into the near future, whereas the eastern population is increasing and appears to be robust (MMS 2003).

Possible causes for the decline may include redistribution, changed vital rates, pollution, predation, subsistence use, commercial harvest, disease, natural fluctuation, environmental changes, and commercial fishing. The last two are now considered the most probable links to the decline. Steller sea lions may be directly affected by commercial fishing through incidental catch in nets, entanglement in derelict debris, or shooting, and indirectly affected through competition for prey, disturbance, or disruption of prey schools (MMS 2003).

3.6.3.10 Northern Sea Otter (Southwest Alaska Distinct Population Segment)

Geographic Boundaries and Spatial Distribution. Sea otters are members of the weasel family and are related to minks and river otters. They live in shallow waters along the North Pacific. The North American range once extended from southern California north and then west through the Aleutian Islands. They inhabit nearshore coastal areas in many parts of south-central and southwestern Alaska. Sea otters from two designated stocks, the southwestern Alaska stock and the south-central Alaska stock, are year-round residents in different areas near or “downstream” of the Cook Inlet lease-sale area, including nearshore areas in parts of western and eastern lower Cook Inlet and associated bays, the Kodiak Archipelago, the Kenai Peninsula, and the Alaska Peninsula (MMS 2003).

The Biological Resource Division of the U.S. Geological Survey conducted aerial surveys of the Cook Inlet region in the spring of 2002. Using these surveys, the USFWS reported an “adjusted estimate” of 6,918 and a minimum population estimate of 5,340 sea otters in Kamishak Bay. The survey results indicate that although considerable numbers of sea otters inhabit the Kamishak Bay area in lower western Cook Inlet, their distribution does not overlap significantly with the lease-sale area (MMS 2003).

Critical Habitat. Critical habitat has not been designated for the southwest Alaska northern sea otter distinct population segment (DPS).

Historical Information. The early Russian settling of Alaska was largely a result of the sea otter industry. Sea otters declined because of hunting until 1911, when it was no longer profitable to hunt them, and they were given protection under the Fur Seal Treaty. In 1960, the state of Alaska assumed management of the sea otters. The state successfully reintroduced sea otters to unoccupied habitat in southeastern Alaska, British Columbia, and Washington. The USFWS assumed management of the sea otter with the Marine Mammal Protection Act in 1972. By the mid-1970s, much of Alaska’s sea otter habitat had been repopulated (USEPA 2002).

Life History. Sea otters mate at all times of the year, and young can be born in any season. However, in Alaska, most pups are born in late spring. Sea otters usually do not migrate. They seldom travel far unless an area has become overpopulated and food is scarce. They are gregarious and can become concentrated in an area, sometimes resting in pods of fewer than 10 to more than 1,000 animals. Breeding males drive nonbreeding males out of areas where females are concentrated. In some areas, the nonbreeding males concentrate in “male areas,” which are usually off exposed points of land where shallow water extends offshore. Bald eagles prey on newborn pups, and killer whales might take a few adults, but predation is probably insignificant. Many sea otters live for 15 to 20 years (65 *FR* 67343, November 9, 2000).

The search for food is one of the most important daily activities of sea otters because large amounts are required to sustain them in healthy condition. Their feeding habits can result in conflicts with subsistence, recreational, and commercial fishers when otters move into areas that support important shellfish resources (65 *FR* 67343, November 9, 2000)).

Sea urchins, crabs, clams, mussels, octopuses, other marine invertebrates, and fishes make up the normal diet of sea otters. They usually dive to the bottom in 1.5–75 meters (5–250 feet) of water and return with several pieces of food, roll on their backs, place the food on their chests, and eat it piece by piece using their forepaws and sometimes a rock to crack shells. In the wild, sea otters never eat on land (65 *FR* 67343, November 9, 2000)).

Unlike seals, which rely on a heavy layer of blubber for protection against the cold North Pacific waters, sea otters depend on air trapped in their fur for maintaining body temperature. If the fur becomes soiled or matted by material such as oil, the insulation qualities are lost. This results in loss of body heat and eventual death. For this reason, otters spend much time grooming their fur to keep it clean (65 *FR* 67343, November 9, 2000)).

Sea otters are hunted by Alaska Natives for subsistence and products used in handicrafts. They are sometimes caught and drowned in fishing nets. The *Exxon Valdez* oil spill dramatically demonstrated the effects of oil contamination on sea otters. More than 1,000 carcasses were found after the spill, and it is likely that the total number that died was several times greater (65 *FR* 67343, November 9, 2000)).

Population Trends and Risks. The most recent population estimate for the southwest Alaska stock is 41,474 animals, with a minimum estimate of 33,203 animals (USFWS 2002b).

In the 1980s, the Aleutian population was estimated at 55,100 to 73,700 individuals. The Aleutian Archipelago was not systematically surveyed in full between the 1980s and 1992. During the 1992 surveys, the estimated Aleutian Islands sea otter population was more than 19,000 (USFWS 2002b), but surveys conducted in the Aleutian Islands in the summer of 2000 resulted in an adjusted population estimate of 8,742 sea otters (USFWS 2002b). The total uncorrected count for the area in 2000 was 2,442 animals, indicating that sea otter populations had declined 70 percent between 1992 and 2000 (USFWS 2002b).

As part of a continued effort to determine the full range of the sea otter's decline in western Alaska, USFWS conducted aerial surveys along the Alaska Peninsula and the Kodiak Archipelago in 2000 and 2001. Surveys of the Alaska Peninsula repeated methods used in a 1986 aerial survey. When current results were compared with those from the previous study, declines of 93 to 94 percent were documented for the southern Alaska Peninsula and declines of 27 to 49 percent were documented for the northern Alaska Peninsula. In the Kodiak Archipelago, data from 2001 aerial surveys indicate that sea otter populations have decreased by as much as 40 percent since 1994 (USFWS 2002b).

A recent aerial survey of Kamishak Bay indicates nearly 7,000 sea otters inhabit this area. Kamishak Bay was previously surveyed as part of a boat-based survey of lower Cook Inlet. An estimate for just Kamishak Bay is not available, therefore the population trend for that area is unknown. Although large portions of the southwest Alaska stock appears to have undergone dramatic population declines, several areas do not appear to have been affected. Estimates from the Port Moller/Nelson Lagoon area and the Alaska Peninsula from Castle Cape to Cape Douglas show evidence of population increases. The magnitude of these increases, however, does not offset the declines observed in the past 10–15 years (USFWS 2002b).

Although disease, starvation, and contaminants have not been implicated at this time, additional evaluation of these factors is warranted. The hypothesis that predation by killer whales is causing the sea otter decline should also be studied further. The USFWS has designated the northern sea otter as a candidate for listing under the Endangered Species Act (65 *FR* 67343, November 9, 2000).

3.7 SOCIOECONOMIC CONDITIONS

The project area, including all facilities, is located within the Kenai Peninsula Borough and a portion of the Kodiak Island Borough. The communities most likely to be affected by the project include Tyonek, Kenai, Nikiski, and Soldotna, and will be the primary focus of this evaluation.

Tyonek is a Dena'ina (Tanaina) Athabascan Village. Various settlements in the area included Old Tyonek Creek, Robert Creek, Timber Camp, Beluga, and the Moquawkie Indian Reservation. In the mid-1700s some trading with the Russians occurred. Between 1836 and 1840, half of the region's native populations died from a smallpox epidemic. The Alaska Commercial Company had a major outpost in Tyonek by 1875. In 1880, Tyonek station and village, believed to be two separate communities, had a total of 117 residents, including 109 Athabascans, 6 creoles, and 2 caucasians. After gold was discovered at Resurrection Creek in the 1880s, Tyonek became a major disembarkment point for goods and people. A saltery was established in 1896 at the mouth of the Chuitna River north of Tyonek. In 1915 the Tyonek Reservation (also known as Moquawkie Indian Reservation) was established. The devastating influenza epidemic of 1918–1919 left few survivors among the Athabascans. The village moved to its present location atop a bluff when the old site near Tyonek Timber flooded in the early 1930s. Tyonek is now an unincorporated city (SAIC 2002).

The Kenaitze Indians (Dena'ina) historically occupied the Kenai Peninsula. The city of Kenai was founded in 1741 as a Russian fur trading post. In the early 1900s, cannery operations and construction of a railroad spurred development. It was the site of the first major Alaska oil discovery (1957), and has been a center for oil and gas exploration and development since that time. The Kenai Peninsula Borough was formed in 1964 (SAIC 2002).

Prior to Russian settlement, Kenai was the site of the Dena'ina Indian village of Shk'ituk't. At the time of Russian settlement in 1741, about 1,000 Dena'ina lived in the village. In 1791 a fortified Russian trading post, Fort St. Nicholas, was constructed for fur and fish trading. In 1869, the U.S. military established a post for the Dena'ina Indians in the area, called Fort Kenay, which was abandoned after the United States purchased Alaska. Through the 1920s, commercial fishing was the primary activity. In 1940, homesteading enabled further development in the area. The first dirt road from Anchorage was constructed in 1951. In 1957, oil was discovered at Swanson River, 20 miles northeast of Kenai, and in 1965, offshore oil discoveries in Cook Inlet fueled a period of rapid growth. Kenai has been a center for area-wide oil and gas exploration, production, and services since that time. Kenai currently has a home-rule form of government (SAIC 2002).

Both Nikiski and Soldotna were developed (by non-Natives) in the 1940s when the land was opened to homesteading. The Nikiski area was further developed as a result of oil and gas activities; by 1964, oil-related operations there included Unocal, Phillips/Marathon, Chevron, Shell, and Tesoro. Soldotna's growth occurred as a result of construction of the Sterling Highway from Anchorage in the late 1940s, and again in the 1950s and 1960s with the discovery and development of oil in the region. Nikiski is an unincorporated city, and Soldotna is headquarters for the Kenai Peninsula Borough (SAIC 2002).

3.7.1 Regional Population and Employment

Table 3-25 provides population data for communities and regions potentially affected by the proposed project. Between 1980, and 1990, Tyonek had a sharp decrease (35 percent) in population; however, from 1990 to 2000, the population recovered somewhat, increasing by 25 percent. Since 1980 Kenai has experienced a 61 percent increase in population, Nikiski has had a 290 percent increase, and Soldotna has had a 62 percent increase. By comparison, the Kenai Peninsula Borough's population increased by 97 percent and Anchorage's population increased by 49 percent in those two decades (SAIC 2002).

Table 3-25. Historical Populations in the Project Area

Year	Tyonek	Kenai	Nikiski	Soldotna	Kenai Peninsula Borough	Anchorage
1900	107	290	–	–	–	–
1910	–	250	–	–	–	–
1920	58	332	–	–	–	1,856
1930	78	286	–	–	–	2,277
1940	136	303	–	–	–	3,495
1950	132	321	–	–	–	11,254
1960	187	778	–	32	6,097	82,833
1970	232	3,533	–	1,202	15,836	124,542
1980	239	4,324	1,109	2,320	25,282	174,431
1990	154	6,327	2,743	3,482	40,802	226,338
2000	193	6,942	4,327	3,759	49,691	260,283

Source: SAIC (2002).

Table 3-26 provides a summary of employment by occupation using 2000 census data. The leading occupation category in the Kenai Peninsula Borough is management, professional, and related (27.4 percent), followed by sales and office (23.3 percent); service (17.0 percent); construction, extraction, and maintenance (16.7 percent); production, transportation, and material moving (13.2 percent); and farming, fishing, and forestry (2.4 percent). Occupation rankings for Kenai, Nikiski, Soldotna, and Tyonek roughly followed the same general trends with 24 to 29 percent of occupations classified as management, professional, and related (DCED 2004).

Table 3-26. Employment by Occupation (Based on 2000 Census Data)

Occupation	Kenai Peninsula Borough	Kenai	Nikiski	Soldotna	Tyonek
Management, Professional, and Related	5,581	688	480	420	15
Service	3,471	539	219	333	21
Sales and Office	4,740	744	338	477	12
Farming, Fishing, and Forestry	485	5	0	10	0
Construction, Extraction, and Maintenance	3,394	405	397	263	9
Production, Transportation, and Material Moving	2,693	477	218	184	7
Total	20,364	2,858	1,652	1,687	64

Source: DCED (2004).

Table 3-27 summarizes employment by industry. The leading industries in the Kenai Peninsula Borough are education, health, and social services (19.6 percent); followed by retail trade (12.6 percent); arts, entertainment, recreation, accommodation, and food services (10.9 percent); agriculture, forestry, fishing and hunting, and mining (10.6 percent); and construction (9 percent). The top industries for the general area are education, health, and social services; retail sales; agriculture, forestry, fishing and hunting, and mining; and arts, entertainment, recreation, accommodation, and food services (DCED 2004).

Table 3-27. Employment by Industry (Based on 2000 Census Data)

Industry	Kenai Peninsula Borough	Kenai	Nikiski	Soldotna	Tyonek
Agriculture, Forestry, Fishing and Hunting, and Mining	2,157	327	199	129	3
Construction	1,898	226	191	82	11
Manufacturing	1,046	160	175	58	0
Wholesale Trade	383	62	38	29	0
Retail Trade	2,568	460	149	296	0
Transportation, Warehousing, and Utilities	1,319	176	72	99	5
Information	294	63	27	11	0
Finance, Insurance, Real Estate, Rental and Leasing	638	69	54	84	0
Professional, Scientific, Management, Administrative & Waste Management	1,046	136	79	57	0
Education, Health, and Social Services	3,996	457	345	344	17
Arts, Entertainment, Recreation, Accommodation, and Food Services	2,209	276	103	268	8
Other Services (Except Public Administration)	1,283	158	138	113	6
Public Administration	1,527	288	82	117	14
Total	20,364	2,858	1,652	1,687	64

Source: DCED (2004).

Table 3-28 provides some additional economic indicators for the general area (also from the 2000 census data). In Tyonek employment was about equally split between private and government employment. In Kenai and Nikiski about 70 percent of the people employed were employed in the private sector. In Soldotna 75 percent were employed in the private sector and 25 percent by some form of government (local, state, or federal). Unemployment in 2000 ranged from 8.9 percent in Soldotna to 27.3 percent in Tyonek, and averaged 11.4 percent for the entire Kenai Peninsula Borough (DCED 2004).

Table 3-28. Other Economic and Employment Indicators (Based on 2000 Census Data)

Economic Parameter	Kenai Peninsula Borough	Kenai	Nikiski	Soldotna	Tyonek
Total Potential Work Force (16+)	36,781	4,960	3,177	2,673	144
Total Employment	20,486	2,869	1,652	1,687	64
Civilian Employment	20,364	2,858	1,652	1,687	64
Military Employment	122	11	0	0	0
Civilian Unemployed (and seeking work)	2,630	406	307	165	24
Percentage Unemployed	11.4%	12.4%	15.7%	8.9%	27.3%
Adults Not in Labor Force (not seeking work)	13,665	1,685	1,218	821	56
Percentage of All 16+ Not Working (unemployed and not seeking work)	44.3%	42.2%	48.0%	36.9%	55.6%
Private Wage and Salary Workers	13,691	2,117	1,158	1,266	31
Self-Employed Workers	2,578	172	230	112	3
Government Workers	3,976	569	252	300	30
Unpaid Family Workers	119	0	12	9	0
Percentage Below Poverty	10.0%	9.8%	11.4%	6.6%	13.9%

Source: DCED (2004).

3.7.2 Oil and Gas Industry

The upper Cook Inlet and Kenai Peninsula have an association with the petroleum industry that dates back to the 1950s. The first discovery in the region took place onshore in 1957, when oil was discovered on the Kenai Peninsula. Except for the Beaver Creek Unit, which began producing oil in 1972, all other oil-producing fields are in state waters. At the height of oil production (1970), the Cook Inlet region produced 82 million barrels a year; by 1983, production had declined to 24.7 million barrels; and by 200,3 production had declined to about 10 million barrels annually (ADNR 2004). Producible quantities of natural gas were first discovered in 1959 in what is now the Kenai Gas Field. Gas production in the Cook Inlet region did not begin until 1960. By 1983, gross annual natural gas production had reached 306 billion cubic feet, with 2.69 billion cubic meters (95 billion cubic feet) reinjected to maintain oil production, for a net production of 5.97 billion cubic meters (211 billion cubic feet). In 2003, total gross gas production in the Cook Inlet region totaled about 5.89 billion cubic meters (208 billion cubic feet); of this amount, 0.11 million cubic meters (4 million cubic feet) was reinjected to maintain oil production (ADNR 2004).

There are 13 active offshore production platforms in Cook Inlet. There are three onshore treatment facilities along the shores of the upper Cook Inlet and approximately 356 kilometers (221 miles) of undersea pipelines, 126 kilometers (78 miles) of oil pipeline, and 240 kilometers (149 miles) of gas pipeline (MMS 2003).

Existing Cook Inlet region crude oil production (offshore and onshore) is handled through the Trading Bay production facility and the Tesoro Refinery. The Trading Bay facility transports its received crude oil via pipeline to the Drift River Terminal, which stores and loads at least 8.2 million barrels annually. Since 1996, all Drift River tanker loadings are transported to Tesoro's refinery in Nikiski (MMS 2003).

The Tesoro refinery can process up to 80,000 barrels per day, although current production is estimated around 50,000 barrels per day. Recent refinery production has been augmented by North Slope oil tankered from Valdez. A 113-kilometer (70-mile) products pipeline links the Nikiski refinery with the Tesoro fuel depot at the Port of Anchorage. Tesoro's refined products include multigrades of gasoline, propane, Jet A fuel, diesel No. 2, diesel, jet fuel 4 (JP4), and No. 6 fuel oil (MMS 2003).

The Phillips-Marathon liquefied natural gas plant was constructed in 1969 and liquefies 1 million tons (approximately 900,000 tonnes) of liquefied natural gas annually. It is the only natural gas liquefaction plant in the United States. Produced liquefied natural gas is shipped by tanker to Japan by 80,000-cubic-meter carriers on an average of once every 10 days (approximately 8.5 metric days) (MMS 2003).

The Agrium chemical plant can process gas to produce more than 1 million metric tonnes of ammonia and a similar quantity of urea pills and granules (for fertilizer). Some of the produced urea is used in Alaska; the rest is shipped to the west coast of the United States in tankers and bulk freighters (MMS 2003).

3.7.3 Commercial Fisheries

The Alaska Department of Fish and Game divides Alaska's commercial fishing waters into four management regions:

1. The Southeast Region (Southeast Yakutat)

2. The A-Y-K Region (Norton Sound/Kotzebue, Yukon, and Kuskokwim)

3. The Westward Region (Kodiak, Chignik, Alaska Peninsula, and Bristol Bay)

4. The Central Region (Prince William Sound, Cook Inlet, and Bristol Bay)

There are numerous districts within these four regions. This section focuses on the Cook Inlet portion of the Central Region and, to a lesser extent, on the Kodiak, Chignik, and South Alaskan Peninsula portions of the Westward Region. Commercial fisheries in these waters include salmon, herring, groundfish (halibut, lingcod, rockfish, sablefish, pollock, and Pacific cod), and shellfish (crab, shrimp, scallops, and clams). The combined ex-vessel value of these fisheries for all Alaskan regions in 2001 was estimated at $871 million (salmon: $216 million; herring: $10 million; halibut: $132 million; groundfish: $397 million; and shellfish: $117 million). Since the mid-1980s, the ex-vessel value of these fisheries in Alaska has declined from a high of about $2.75 billion in 1988 to $871 million in 2001 (MMS 2003).

3.7.3.1 The Shellfish Fishery

Cook Inlet and the waters adjacent to Kodiak and Chignik have supported commercial shellfish fisheries for red king, tanner, and Dungeness crabs; the weathervane scallop; hard-shell clams; razor clams (Cook Inlet); shrimp; and in recent years, sea urchin and sea cucumber (Kodiak and Chignik). Because of low abundance levels in the Cook Inlet area, the fisheries for red king, tanner, and Dungeness crabs and for shrimp have been closed for some time. Only fisheries for the weathervane scallop and hard-shell and razor clams remain open in the Cook Inlet area. Because of low abundance levels in the Kodiak area, the red king crab commercial fishery has been closed since 1995. More extensive commercial fisheries for king and Dungeness crabs and other shellfish should occur again in future years as the stocks increase (MMS 2003).

Scallops. Weathervane scallops are harvested by vessels towing dredges, mostly in waters 70–110 meters (230–360 feet) deep. Scallops are harvested commercially in some years, but these efforts have been limited until recently. In the Cook Inlet area, the commercial fishery for weathervane scallops began in 1983. Catches have been sporadic and centered around a single scallop bed near Augustine Island in the Kamishak District of lower Cook Inlet, which has produced all of the catches since 1983. The scallop catches and fishing effort peaked at 13 tonnes in 1996, but are set by regulation at 9 tonnes. The Kodiak fishery for weathervane scallops began in 1967, peaked at 643 tonnes in 1970, and declined to zero in 1977 and 1978. Since 1980 catches have fluctuated between 21 and 313 tonnes. Since the 1960s, a number of scallop beds off Kodiak Island have been closed because of a high bycatch rate of king and tanner crabs and because the scallop dredges injure soft-shell crabs (MMS 2003).

Clams, Sea Cucumbers, and Sea Urchins. Other shellfish commercially fished in the Cook Inlet area are Pacific hard-shell and razor clams, sea cucumbers, and sea urchins. Most of the hard-shell clams harvested are Pacific little neck (mostly from Kachemak Bay) and butter clams. In the Kodiak and Chignik areas, other shellfish commercially fished include the red sea cucumber and the green sea urchin, both of which are harvested by hand by divers. The red sea cucumber fishery began in 1991–1992 (Ruccio and Jackson 2002), and the peak catch was 256 tonnes in 1993 (MMS 2003). The catch has declined drastically since then and has remained at 53–60 tonnes because of management restrictions. Off Kodiak Island, the green sea urchins are harvested for their roe. The fishery began in 1980, and the fishing effort has varied through 1999 (MMS 2003).

3.7.3.2 The Herring Fishery

Pacific herring are harvested annually in Cook Inlet in addition to the waters adjacent to Kodiak, Chignik, and the southern Alaskan Peninsula. In the upper Cook Inlet area, commercial herring fishing began in 1973. Harvests have averaged well under 400 tons a year (less than $200,000 ex-vessel value), which makes it one of the smallest herring fisheries in the state. There are three primary fisheries in the upper Cook Inlet area: the eastside, the Chinitna Bay, and Tuxedni Bay fisheries. Because of low stock abundance, all of these were closed to fishing by 1993. In 1998 the eastside fishery was reopened from April 15 to May 20, but for only 2 days a week. Since 1998, the ex-vessel value of the upper Cook Inlet fisheries has dropped to less than $20,000 a year (MMS 2003).

In the lower Cook Inlet area, commercial herring fishing began in 1914 with the development of a gill-net fishery in Kachemak Bay. A purse seine fishery developed there in 1923, but by 1926 the herring population and the fishery had collapsed. The next lower Cook Inlet herring fishery began in 1939 in the eastern district, which is farthest from lower Cook Inlet and is centered in Resurrection Bay. It ended in 1959 when stocks declined, apparently as the result of overexploitation. In response to Japanese market demand, a sac roe herring fishery developed in lower Cook Inlet in the 1960s. However, from 1961 to 2001, the southern, eastern, and outer districts were either not fished or closed much of the time because of low stock abundance. Since 1973, most lower Cook Inlet sac roe harvests have occurred in the Kamishak Bay district, where abundances are higher. Harvests have ranged from 243 tons in 1973 to a high of 6,132 tons in 1987. From 1973 to 1998, ex-vessel values in the Kamishak Bay district ranged from $70,000 to $9,300,000. Because of low stock abundance, the Kamishak Bay fishery was closed in 1980, but it was opened again in 1985 when stocks improved. However, the Kamishak Bay fishery was closed again in 1999 for the same reason and has remained closed (MMS 2003).

3.7.3.3 The Salmon Fishery

All five species of Pacific salmon are harvested commercially (as well as for subsistence and sport fishing) in Cook Inlet (Table 3-29). Alaska's salmon fishery is second only to the state's groundfish fishery in volume and value. Salmon fisheries in Shelikof Strait and near Kodiak Island are closely equivalent to those in Cook Inlet, with slightly different fishing seasons and periods. Cook Inlet and Kodiak salmon fisheries use purse seines, drift gill nets, set gill nets, and (in small numbers) beach seines. The regional salmon fisheries commence in early May and continue well into September every year (MMS 2003).

In recent years, the combined ex-vessel value of commercially harvested salmon in Alaska has been declining from a high of $487 million in 1995 to a low of $216 million in 2001. This trend also has occurred in the Cook Inlet, Kodiak, Chignik, and the southern Alaska Peninsula areas. The ex-vessel value of salmon landed in Cook Inlet during this time ranged from a high of $35.2 million in 1997 to a low of $8.8 million in 2001. In Kodiak, the ex-vessel value of salmon ranged from a high of $53.9 million in 1995 to $18.9 million in 2001 (MMS 2003). Sockeye are commercially harvested in much greater numbers in upper Cook Inlet than in lower Cook Inlet. Because of the pink salmon hatcheries in lower Cook Inlet, pink salmon are commercially harvested in much greater numbers there than in upper Cook Inlet. Because of this, and the fact that commercially harvested sockeye sell for 5 to 7 times the price that pink salmon sell for, upper Cook Inlet accounts for most of the ex-vessel value of salmon within the Cook Inlet area. For example, in 1995 the value of commercially harvested salmon in the upper Cook Inlet Management Area was estimated at about $22 million, whereas the value of commercially harvested salmon in the lower Cook Inlet districts was estimated at about $2.76 million (MMS 2003).

Table 3-29. Commercial Salmon Harvest in Upper Cook Inlet

Year	Chinook	Sockeye	Coho	Pink	Chum
1993	18,749	4,755,012	306,858	100,918	122,767
1994	19,937	3,543,047	579,954	518,747	299,323
1995	17,860	2,960,646	450,787	133,850	531,215
1996	14,248	3,888,788	321,411	242,911	156,457
1997	13,235	4,176,696	152,404	70,928	103,036
1998	7,997	1,218,956	160,644	551,345	95,654
1999	14,128	2,680,707	125, 343	16,129	174,243
2000	7,229	1,322,180	236,128	146,156	126,927
2001	9,295	1,826,833	113,311	72,559	84,494
2002	12,069	2,761,886	244,014	436,380	225,446
Average	12069	2761886	244014	---	191,956.2
Odd Year	---	---	---	60345	---
Even Year	---	---	---	61,480	---

Source: ADFG (2003).

3.7.3.4 The Groundfish Fishery

Groundfish are commercially harvested in all four Alaska Department of Fish and Game commercial fishing regions. This includes the Cook Inlet area of the Central Region, and the Kodiak, Chignik, and the southern Alaska Peninsula waters of the Westward Region. The groundfish fishery is the largest commercial fishery in Alaska by volume and value. Most Alaskan groundfish are landed in the Bering Sea/Aleutian Islands area of the Central Region outside the lease-sale area. Commercially harvested groundfish of the Central and Westward regions have included rockfish (numerous species), flatfish (including halibut), Pacific cod, lingcod, sablefish, and pollock. One or more of these fisheries may operate during most of the year in the proposed multiple lease-sale area and in the Kodiak, Chignik, and the southern Alaska Peninsula fisheries south of the lease-sale area. Species landed as bycatch include spiny dogfish, Pacific sleeper shark, Pacific salmon shark, majestic squid, giant Pacific octopus, and various species of skates (MMS 2003).

The lower Cook Inlet and Kodiak/Shelikof Strait longline fishery harvests consist primarily of sablefish (black cod), Pacific cod, and halibut. Groundfish landings and ex-vessel earnings in the Cook Inlet area for sablefish, rockfish, lingcod, Pacific cod, pollock, and other species have varied substantially over time. Landings in 1988 totaled 897,013 pounds (ex-vessel value of $279,965), but increased considerably in 1991 when they jumped to 2,346,558 pounds (ex-vessel value of $635,719). Since 1991, landings increased to 13,434,633 pounds in 1998 (ex-vessel value of $1,729,404), but declined to 1,698,971 pounds in 2001 (ex-vessel value of $842,055). Halibut is the major commercial groundfish in the Cook Inlet area with landings (Homer, Kenai, Ninilchik, Seldovia, and Seward) totaling 15,346,912 pounds in 2000, and 19,787,911 pounds in 2001. At $2.60 per pound (the minimum price that year), this represents an ex-vessel value of at least $51,448,568 in 2001. More than 30 percent of the total Cook Inlet halibut harvest in 2000 and 2001 was landed in Seward, which is in the Eastern District of the lower Cook Inlet Management Area. Because of low stock abundance, the 2002 Cook Inlet fishery for pollock is closed, except for bycatch. For the same reason, the sablefish, rockfish, and lingcod fisheries of the Cook Inlet area are subject to short seasons, emergency orders, gear restrictions, trip limits, restricted fishing locations, parallel or directed fishery restrictions, or several of the above. The 2002 Cook Inlet fishery for Pacific cod is limited to bycatch only for longline gear, but is open to pot and jig gear (with some conditions) (MMS 2003).

Except for halibut, groundfish landings and ex-vessel earnings in the Kodiak, Chignik, and the southern Alaska Peninsula fisheries are much higher than those of the Cook Inlet area and include more species. From 1988 to 2001 the ex-vessel value of the Kodiak groundfish fishery (excluding halibut) ranged from a low of $15,838,460 in 1989 to a high of $40,983,750 in 2000. The ex-vessel value of the Chignik groundfish fishery ranged from a low of $1,056,366 in 2001 to a high of $6,290,632 in 1991, and the southern Alaska Peninsula groundfish fishery ranged from a low of $3,189,992 in 1993 to a high of $21,741,956 in 2000. The combined groundfish landings of Kodiak, Chignik, and the southern Alaska Peninsula were 81,121,861 pounds in 2000 (more than 95 percent of which were Pacific cod and pollock). The combined ex-vessel value of the groundfish fishery (excluding halibut) in this portion of the Westward Region was $65,531,787 in 2000, and $45,762,618 in 2001. Halibut landings in the Kodiak and Chignik areas totaled 9,677,932 pounds in 2000, and 8,993,840 pounds in 2001. The price of $2.40 per pound (the estimated average for 2001) represents an ex-vessel value for halibut of about $21,585,216 in 2001 (MMS 2003).

3.7.4 Subsistence Harvesting

Subsistence is defined by the Alaska National Interest Lands Conservation Act, Section 803, as follows:

> ...the customary and traditional uses by rural Alaska residents of wild, renewable resources for direct personal or family consumption as food, shelter, fuel, clothing, tools, or transportation; for the making and selling of handicraft articles out of non-eatable by-products of fish and wildlife resources taken for personal or family consumption; for barter, or sharing for personal or family consumption; and for customary trade.

The discussion below focuses on practices by households that might be altered or affected by the proposed project. The use areas and practices differ as greatly as the size and socioeconomic character of each area's populations. Local subsistence values are critical in that households feel their subsistence activities are important, necessary, and satisfying within their overall cultural context. Although many animals and plants might be taken for subsistence, it is the most common practices that are recorded and reported, especially for the west side of the inlet (SAIC 2002).

Subsistence tends to occur in areas in close proximity to settlements. These practices also tend to occur where there is easy access and where the biomass concentration is high. The increasing human population on the east side of the inlet has placed limits on subsistence practices, while on the west side of the inlet, many traditional practices continue with a greater diversity of species. Some subsistence practices are frequently conducted in conjunction with recreation (and should not be confused with recreational activities) on both sides of the inlet (SAIC 2002).

Numerous TEK interviewees observed that many local resources have declined in abundance and/or species important to subsistence have or are experiencing deformities, sickness, or other abnormalities (SRB&A 2005). According to some interviewees, some tribal members have decreased their subsistence harvest because of concern about contaminant levels in those foods (SRB&A 2005). In addition to the importance of a subsistence diet to tribal health and cultural, an interviewee noted that the lack of [consumable] fish contributed to the lack of income, lack of healthy activity, lack of tradeable skills, lack of esteem in providing for family, and a drastic diet change, amongst other things (SRB&A 2005).

Tyonek is a critical subsistence focus area given its proximity to the project. Tyonek TEK interviewees noted that the numbers of seals, sea lions, beluga and clams have declined. They also noted fewer ducks and geese. Interviewees wondered if these changes are associated with platform operations and discharge. While traditional harvest practices have changed from a complete reliance on subsistence foods, which was, as one interviewee said “our lifestyle before modernization,” Tyonek interviewees explained that subsistence continues to be a vital part of their lives. They also explained that their practices have changed in recent years due to decline in abundance of resources, observations of deformities and sickness in resources, and fear of contaminants in the water and resources (SRB&A 2005).

Interviewees expressed the view that they do not have enough information to trace these changes to oil and gas industry operations, but they suspect that such operations are a contributing factor. They also noted garbage washing up on the beach and air, water and noise pollution that all affect their harvest practices to some degree, and they suspect or assume these originate in part from the oil platforms. In addition, Tyonek TEK interviewees noted that the water along the shore is much shallower in recent years due to a build-up of silt. This change causes fish to swim further from shore and makes set-netting and negotiating the water in a boat more difficult. Interviewees postulated that this change might be due in part to the oil platforms, based on their observations that the local dock contributes to this “buildup.” They believe that the large size of the legs of the platforms would contribute to this buildup in a similar way as the dock (SRB&A 2005).

Changes in the abundance of subsistence resources is also an issue in other communities. For example, TEK interviewees from Seldovia observed that many local resources are declining in abundance or have declined in recent years or over the past few decades. These include clams, cockles, and other intertidal species in Seldovia Bay (SRB&A 2005). According to Nanwalek TEK interviewees, traditional harvest areas and subsistence practices have changed in recent years, particularly harvest areas for halibut, which change according to the salmon cycle (SRB&A 2005).

Port Graham TEK interviewees have observed a decline or disappearance in a number of marine subsistence resources in recent years and decades. These include clams, cockles, crabs, bidarkis, octopus and other intertidal species, halibut and other bottomfish, flounder, bull head, “yellowbelly” (tomcod), as well as marine mammals such as seal and whales. Although Port

Graham interviewees generally noted a decline in marine resources, one person expressed the view that resources important to him are adequately available (SRB&A 2005).

Kenai TEK interviewees stated that in recent years they have observed changes in abundance of subsistence resources, including beluga, salmon, hooligan, and clams. When asked, interviewees indicated that they had not observed changes in waterfowl size or abundance (SRB&A 2005).

Ninichik TEK interviewees noted numerous changes in abundance of marine species. Red salmon and king salmon have declined in abundance in the rivers. Steelhead have essentially disappeared. Beluga have declined. Tanner, king, and Dungeness crabs have declined, as have shrimp. Both mussels and clams are less abundant. Bull kelp has largely disappeared, replaced by fluffy leaf seaweed. Waterfowl such as swans, ducks, geese and cranes and land mammals such as moose, wolf and bear have also declined. Sea otters have increased (SRB&A 2005).

The following discussions focus on marine-related activities. Although terrestrial subsistence activities do occur, they are distant from and highly unlikely to be affected by the proposed development. Table 3-30 provides information on the use of local resources in Tyonek (SAIC 2002).

Table 3-30. Resource Harvest Summary for Tyonek

Resource Group[a]	Annual Per Capita Harvest (Pounds)
Fish	191.64
Salmon	186.63
Non-salmon fish	5.01
Land Mammals	56.05
Large land mammals (moose)	54.95
Small land mammals (beaver and snowshoe hare)	1.1
Marine Mammals (beluga whales)	2.56
Birds and Eggs	1.77
Migratory birds	1.43
Other birds	0.33
Marine invertebrates (clams)	4.51
Vegetation (plants, greens, mushrooms)	3.41
Total	259.93

Source: ADFG 1999, as cited in SAIC 2002 (data from 1983 survey).

[a] Species in parentheses account for harvest for entire resource group.

3.7.4.1 Anadromous Fish

Many fish are harvested through subsistence and related activities, although salmon are the most important. The Alaska Department of Fish and Game has a number of established subsistence and educational fisheries in Cook Inlet. Within the upper inlet, these include the Tyonek subsistence salmon fishery, the Native Village of Eklutna educational fishery, and the Knik Tribal Council educational fishery. These are discussed in the following paragraphs. There are several other subsistence and educational fisheries in the inlet below the Forelands; however, they are not addressed because it is unlikely that fish potentially involved in these fisheries would encounter the project area (SAIC 2002).

Tyonek Subsistence Salmon Fishery. The subsistence fishery in the Tyonek area was created by court order in 1980. It was originally open only to people living in the village of Tyonek, but now any Alaskan may participate. Fishing is allowed only in the Tyonek Subdistrict of the Northern District. Only one permit is allowed per household and each permit holder is allowed a single 10-fathom gill net having a mesh size no greater than 6 inches. Fishing is allowed on specific days between May 15 and June 15, or until 4,200 Chinook salmon are taken. The permit allows 25 salmon per permit holder and 10 salmon for each additional household member. Chinook salmon harvests have ranged from 797 in 1990 to 2,750 in 1983 (Table 3-31).

Native Village Educational Fisheries. In 1993 the Alaska Department of Fish and Game (ADFG) issued permits to Alaska residents accompanied by an Eklutna Native village member or a Knik Tribal Council member to participate in this fishery. The permit allows each village to operate a single 10-fathom set gill net having a mesh size no greater than 6 inches. The net may be set in Knik Arm adjacent to the village or in the waters within 1 mile from mean high water in an area from Goose Bay Creek north to Fish Creek. The total catches were 200 and 275 salmon for the Eklutna and Knik fisheries, respectively, in 1996 (SAIC 2002).

Table 3-31. Salmon Catch from the Tyonek Subsistence Fishery

Year	Permits	Chinook	Sockeye	Coho	Pink	Chum
1980	67	1,936	262	0	0	0
1981	70	2,002	269	64	32	15
1982	69	1,565	209	113	15	4
1983	75	2,750	185	40	0	2
1984	75	2,354	310	66	3	23
1985	76	1,720	44	8	0	10
1986	65	1,523	198	210	45	44
1987	64	1,552	161	149	5	24
1988	47	1,474	52	185	6	9
1989	49	1,314	67	175	0	1
1990	42	797	92	366	124	10
1991	57	1,105	25	80	0	0
1992	57	905	74	234	7	19
1993	53	1,247	43	36	11	9
1994	49	840	41	111	0	22
1995	55	1,271	45	123	14	15
1996	48	993	65	61	20	18

Source: SAIC (2002).

3.7.4.2 Other Fish

Eulachon (hooligan) are taken in set nets and by dip netting along the west side of the upper inlet from Tyonek south to Shirleyville for both subsistence and personal use. About a quarter of all Tyonek households seek hooligan. Other species of fish are taken in small numbers. Rainbow trout are occasionally taken. Dolly Varden char are incidental to the taking of salmon in nets, but are also taken in fresh water. About 15 percent of Tyonek households seek fresh water species (SAIC 2002).

3.7.4.3 Shellfish

Approximately 18 percent of the Tyonek households collect shellfish as subsistence activities. Cockles and razor clams are both taken in the lower inlet between Drift River and Tuxedni Bay. These areas are well out of the project area (SAIC 2002).

3.7.4.4 Marine Mammals

Two types of marine mammals are taken as part of the subsistence harvest. Beluga whales are actively sought, and harbor seals are usually taken incidentally. Only 11 percent of Tyonek households attempt to take marine mammals, and mammals' actual contribution to the Tyonek diet is low (SAIC 2002).

Beluga Whales. Beluga whales are taken for subsistence, especially by urban Alaska Natives from the greater Anchorage area. The focus of the harvest is at the mouth of the Susitna River. Some have also been shot just outside the mouth of the Kenai River because local firearms ordinances limit the discharge of guns within the city limits.

Prior subsistence harvests of belugas have resulted in a substantial decline in their population to the extent that they are currently listed as a depleted species under the Marine Mammal Protection Act. Under the depleted status, future subsistence take is proposed to be limited to two belugas annually. Table 3-32 provides estimates of the subsistence take of belugas from 1988 to 1998 (SAIC 2002).

Harbor Seals. Harbor seals are normally taken only incidentally. They may be harvested while in pursuit of other subsistence interests or in transit to subsistence areas. Most frequently harbor seals are taken around set net sites during salmon season.

Table 3-32. Summary of Cook Inlet Beluga Population and Native Subsistence Harvests

Year	Estimated Population	Estimated Subsistence Take
1988	–	25
1989	--	24
1990	--	16
1991	653	20
1992	--	--
1993	--	20
1994	653	--
1995	491	67
1996	594	98
1997	440	70
1998	347	78

Source: SAIC (2002).

3.7.4.5 Birds

Waterfowl, including many species of ducks and geese, are taken around the Trading Bay area. As many as 47 percent of the Tyonek households seek waterfowl in the nearshore marshes (SAIC 2002).

3.8 LAND AND SHORELINE USE AND MANAGEMENT

Most of the area surrounding the upper inlet is in public ownership, including large tracts of federal and state lands (Figure 3-13). Specific land uses include federal parks and wildlife refuges, state game refuges, critical habitat areas, and recreational use areas. The west side of the upper inlet is primarily held by Native groups or by the state of Alaska. There are large blocks of land owned or selected under the Alaska Native Claims Settlement Act by various native corporations, as well as several Native Allotments (SAIC 2002).

3.8.1 Current Land Use

Current land uses in the vicinity of the onshore pipeline route are primarily associated with the oil and gas industry with only limited use by local residents. The beach area around the West Foreland may be used for set net fisheries during the summer (mostly as a Native subsistence activity). The shore area is backed by 15- to 75-meter high bluffs (50- to 250-feet), and the area on top of the bluff is primarily used by the oil and gas industry, although some cabins are on top of the bluff and Native subsistence activities may occur there also (SAIC 2002).

3.8.2 Coastal Zone Management

The Federal Coastal Zone Management Act and the Alaska Coastal Management Act were enacted in 1972 and 1977, respectively. Through these acts, development and land use in coastal areas are managed to provide a balance between the use of coastal areas and the protection of valuable coastal resources. Local coastal districts can develop coastal management programs and tailor statewide standards to reflect the local situations. These coastal management programs are incorporated into the Alaska Coastal Management Program after they are approved by the Alaska Coastal Policy Council and the Secretary of the U.S. Department of Commerce through the Office of Ocean and Coastal Resource Management (MMS 2003).

Both coastal districts adjacent to the lease-sale area have approved coastal management programs. These districts are the Kodiak Island Borough and the Kenai Peninsula Borough (Figure 3-14). Kodiak Island Borough's Coastal Management Program was fully incorporated into the Alaska Coastal Management Program in 1984. Activities that could affect fish and fishing resources and the fishing industry are carefully regulated through the borough's coastal management program policies. In addition, the coastal management program contains policies that specifically address activities associated with oil and gas exploration and development (MMS 2003). The portion of the Bristol Bay Coastal Resource Service Area that abuts Shelikof Strait has been incorporated into the Kodiak Island Borough. Until the Kodiak Island Borough amends its coastal management program to include the western Shelikof area incorporated by the borough, the enforceable policies of the Bristol Bay Coastal Resource Service Area's Coastal Management Program are the enforceable policies for that portion of the Shelikof coast. The policies of the Bristol Bay Coastal Resource Service Area's Coastal Management Program emphasize the protection of fish resources and the fishing industry. They also augment the 16 statewide standards for siting energy facilities that are related directly to oil and gas development (MMS 2003).

The Kenai Peninsula Borough's Coastal Management Program was fully incorporated into the Alaska Coastal Management Program in 1990. Borough-wide policies are general and not intended to create a substantial change from the existing statewide standards. More detailed planning is expected to occur through the use of special plans for "Areas that Merit Special Attention" (MMS 2003). The first of the Areas That Merit Special Attention plans, the Port Graham/Nanwalek Areas that Merit Special Attention, was approved by the Coastal Policy Council in October 1991 and incorporated into the Alaska Coastal Management Program in 1992 (MMS 2003).

The Lake and Peninsula Borough's Coastal Management Program became effective on October 31, 1996, and has been incorporated into the Alaska Coastal Management Program. The borough lies inland of the lease-sale area's boundaries; however, some of its enforceable policies might be applicable to outer continental shelf activities in Cook Inlet (MMS 2003).

3.9 TRANSPORTATION INFRASTRUCTURE

In comparison with the rest of Alaska, the Cook Inlet area has a well-developed transportation system, including a highway network, airports, and marine ports. This section provides a brief summary of air, surface, and marine transportation within the proposed project area.

3.9.1 Air Transportation

The project area is immediately served by two airfields: one at Kenai and the other at Homer. The Kenai airport has a single 46-meter by 2,309-meter (150 by 7,575 feet) runway that is equipped for night operations. In 2001, the airport experienced 78,900 operations, 34,100 of which were air-taxi operations. There are 101 aircraft, including 8 helicopters, based in the Kenai airport. The city of Kenai is served by scheduled passenger flights from Anchorage (MMS 2003).

The Homer airport has a single 46-meter by2,042-meter (150 by 6,701 feet) runway. Although equipped for night operations, the field has no control tower and is not maintained between 10 p.m. and 8 a.m. Homer is served by scheduled passenger flights from Anchorage. In 2001, the airfield processed an estimated 35,100 flight operations, 20,700 of which were attributable to air taxis. There are 91 aircraft based at the Homer airfield, 3 of which are helicopters. Both fields could service midrange cargo aircraft such as C-130s in addition to smaller cargo and passenger jets (MMS 2003).

3.9.2 Surface Transportation

The Cook Inlet–Kenai Peninsula region is connected to Anchorage and the North American highway system by one 224-mile highway. The route is divided into an 89-mile segment that is part of the Seward Highway and the Sterling Highway, which comprise the balance of the connection. The Seward Highway is approximately 127 miles long. It begins in Seward and terminates in Anchorage. At mile 89, the road has a turnoff to the beginning of the 135-mile-long Sterling Highway. The Seward Highway has been designated a National Forest Scenic Byway, because it passes saltwater bays, ice-blue glaciers, and alpine valleys (MMS 2003).

The Sterling Highway extends south past the city of Kenai, along the shore of Cook Inlet, and terminates at the Homer Spit. Should recoverable quantities of hydrocarbons be found in lower Cook Inlet and an onshore pipeline constructed, most of the activity would be along this highway. The Alaska Department of Transportation and Public Facilities has a 10-year improvement plan for the Sterling Highway and is now beginning the upgrade of the road north of the city of Kenai (MMS 2003).

Vehicle traffic on the various Sterling Highway segments varies substantially according to season. According to monthly average traffic data for three Sterling Highway segments—one at the north end of the Sterling, one just east of the City of Kenai, and one in the south at Anchor Point—summer traffic levels can exceed three times those of winter. In the year 2000, monthly average daily traffic for the northern segment reached 7,000 vehicles in summer; in winter, only 2,000 vehicle passages were noted. For the Kenai segment, there were 12,000 summer and 5,700 winter passages; for the Anchor Point area, 4,300 vehicles were counted in the summer and 1,500 in the winter (MMS 2003).

Because of the often intense use of the Seward and Sterling highways during the summer, the Alaska Department of Transportation and Public Facilities limits the use of these highways by long combination trucks (dual-axle trailers) to weekdays only between June 15 and October 1 (MMS 2003).

3.9.3 Marine Transportation

3.9.3.1 Homer

The port of Homer includes a small boat harbor, a state ferry terminal, a general purpose dock, and numerous private barge landings. The dock is capable of handling vessels of up to a 40-foot draft. Primary use of the area includes state ferry traffic to points further south (about twice weekly during summer and fall months), U.S. Coast Guard vessels (usually one is in the general area at all times), and cargo vessels (bulk wood pulp ships visit the area year-round to load wood chips). Smaller cargo vessels, fishing boats, and numerous pleasure craft use the adjacent small boat harbor area (SAIC 2002).

The general Homer area also serves as a point of embarkation and debarkation for marine pilots who are required for larger vessels operating in Cook Inlet (SAIC 2002).

3.9.3.2 Kenai

The port of Kenai includes a number of docks along the Kenai River near its mouth. Vessel use is limited to those generally less than 10 feet in draft. The commercial fishing industry is the port's primary user (SAIC 2002).

3.9.3.3 Nikiski

The Nikiski area has three docks for deeper draft vessels. These are, from south to north, the Unocal Agricultural dock, the Phillips/Marathon dock, and the Tesoro dock. The Unocal dock is dedicated to loading urea and ammonia from Unocal's onshore petrochemical plant for shipment to various locations worldwide. The Phillips/Marathon dock is also a dedicated dock that loads two dedicated liquid natural gas (LNG) tankers for shipment of LNG to the Tokyo area. The Tesoro dock is primarily used to handle tanker and oil barge traffic associated with Tesoro's refinery near the dock area. These docks can typically handle vessels having drafts of 40 to 42 feet (SAIC 2002). There are also several commercial docks that are used primarily for handling barge and supply vessel traffic, primarily associated with oil and gas or construction activities in the general area. These include the Rig Tenders Dock immediately north of the Tesoro dock and the OSI dock several miles north of the East Foreland in Nikishka Bay (SAIC 2002).

3.9.3.4 Drift River Terminal

The Drift River Terminal, owned and operated by Cook Inlet Pipe Line Company, is dedicated to loading oil produced on the west side of Cook Inlet. Vessel traffic is limited to oil tankers that travel to the Nikiski area or to points outside Cook Inlet (SAIC 2002).

3.9.3.5 West Side Barge Landings

There are a number of barge landings on the west side of Cook Inlet that are primarily used in support of oil and gas operations. These include landings at the Trading Bay Production Facility (oil/gas), Shirleyville (local residents and oil/gas), Ladd (local residents and oil/gas in the Beluga area), and Beluga River (local residents) (SAIC 2002).

3.9.3.6 North Forelands

The North Forelands dock was originally constructed for bulk loading of wood chips from timber operations in the general Tyonek area. These operations were discontinued in the 1980s and the dock is currently operated by the Tyonek Native Corporation. The dock and immediate area is being promoted as a site for industrial development (SAIC 2002).

3.9.3.7 Port of Anchorage

The port of Anchorage is the largest port in Cook Inlet and is at the head of the inlet. It can handle containerized and bulk cargo, refined petroleum products, general cargo, and passenger traffic. Current traffic at the dock includes container vessels (SeaLand and Tote), oil tankers and barges carrying refined products, and some cruise ship traffic in the summer months (Table 3-33). There are also several private wharves in the area that are used by barges and smaller cargo vessels, as well as facilities that handle small recreational and commercial fishing boats in the area (SAIC 2002).

Table 3-33. Vessel Traffic in the Port of Anchorage

Year	Self-Propelled Vessels			Non Self-Propelled		
	Passenger and Dry Cargo	Tanker	Tow or Tug	Dry Cargo	Tanker	Total
1987	202	39	51	143	26	461
1988	252	17	167	149	33	618
1989	195	17	402	132	13	706
1990	213	5	107	70	15	410
1991	286	94	268	176	13	837
1992	–	–	–	–	–	–
1993	228	14	111	65	9	427
1994	239	25	66	38	11	397
1995	231	33	71	42	30	407
1996	260	61	32	29	38	420

Source: SAIC (2002).

3.10 RECREATION, TOURISM, AND VISUAL RESOURCES

Much of Cook Inlet's recreational value is based on some access to the outdoor environment, and many recreational uses involve public lands and depend on the use of public waterbodies. Recreation activities may be classified as "coastal-dependent" or "coastal-enhanced." Coastal-dependent activities require access to the coastline and water for the activity to take place. These endeavors include boating, fishing, sailing, kayaking, marine wildlife viewing, and beachcombing. Coastal-enhanced activities, although not directly dependent on access to the coastline and water, derive increased quality for participants from the proximity to the coast. These endeavors include hiking, biking, running, nature appreciation, camping, photography, and horseback riding (MMS 2003). The recreation values of the region and tourism are linked. Recreation values contribute to the quality of life for Alaska residents, and through the expenditures made in their pursuit, recreation values contribute to the area's economy. In turn, these values are an important component of tourism, attracting in-state and out-of-state pleasure tourists to the area. Many of the recreation and tourism activities in the area rely on the region's scenery, rivers and lakes, coastal waters, and abundance of fish and wildlife resources. The scenic quality of the area enhances the setting for coastal-dependent and coastal-enhanced recreation and is a major attraction in itself. The entire coastline of the Cook Inlet basin holds an abundance of vistas, natural features, and man-made scenic resources of varying aesthetic value. Scenic resources include wetlands, tidal flats, beaches, vertical bluffs, rocky coasts, lakes, stream corridors, undulating hills, bays, and inlets. The existing oil and gas platforms in Cook Inlet have been part of the coastal viewshed for more than 40 years. Table 3-34 lists the national and state parks and special use areas in the Cook Inlet area.

Table 3-34. National and State Parks and Other Special Areas of Cook Inlet

Resources	Area (acres)
National	
Katmai National Park and Preserve	4,093,240
Lake Clark National Park and Preserve	4,440,130
Kenai National Wildlife Refuge	~2,000,000
Kodiak National Wildlife Refuge	1,900,000
Alaska Maritime National Wildlife Refuge (Gulf of Alaska Unit)	475,000
Becharof National Wildlife Refuge	1,157,000
Alaska Peninsula National Wildlife Refuge (Ugashik and Chignik Units)	2,648,100
Anikchak National Monument and Preserve	603,000
Kachemak Bay Estuarine Research Reserve	350,000
Kenai Fjords National Park	670,000
State	
McNeil River State Game Sanctuary	128,000
Captain Cook State Recreation Area	3,620
Clam Gulch State Recreation Area	Not reported
Ninilchik State Recreation Area	97.35
Deep Creek State Recreation Area	Not reported
Stariski State Recreation Area	30.05
Anchor River State Recreation Area	Not reported
Kachemak Bay State Park and Wilderness Park	328,290
Ft. Abercrombie State Historic Park	182,720
Pasagshak State Recreation Site	20.14

Source: MMS (2003).

3.10.1 Sport Fisheries

The marine sport fisheries of Cook Inlet are the focus of a large and growing recreation-based economic sector. Sportfishing provides monetary benefits to tourism-related businesses. Sport fishing in Cook Inlet is primarily for Pacific halibut. The marine salmon fishery (i.e., Chinook and coho) is both a substitute and complement for the halibut sport fishery. Halibut sportfishing catches in Cook Inlet have gradually increased from 1977 to 1998. Also, the percentage of halibut sportfishing of the total sport and commercial halibut fishing has increased steadily between 1977 and 1998. Another increase related to sport fisheries has to do with vessels: the number of vessels licensed for sport or sport/commercial fishing off Alaska has increased steadily from 500 in 1984 to more than 1,500 in 1996 (MMS 2003).

TEK interviewees stated that they have observed declines in the abundance of marine species, in particular within the traditional areas where halibut were harvested and that commercial fishing and an increase in [tourism-related] charter fishing has put considerable pressure on subsistence practices and resources (SRB&A 2005).

Of a total 198,000 person-days spent fishing in lower and central Cook Inlet in 1997, approximately 79,000 were spent on charters, 91,000 were spent on private or bare-boat charters, and 28,000 were shore-based. Sport fishers include local fishers from the Kenai Peninsula, other Alaskans (from outside the Kenai Peninsula), and nonresidents of Alaska. The average daily expenditures for lower and central Cook Inlet sport-fishing trips in 1997 and 1998 ranged from $32 for a local resident fishing from shore to $294 for a nonresident of Alaska on a charter. These expenditures include the cost of automobile or truck fuel, automobile or recreational vehicle rental, airfare, other transportation, lodging, groceries, restaurant and bar, charter or guide, fishing gear, fish processing, derby fees, boat fuel and repairs, and moorage or haulout. The total expenditures by all sport fishers fishing in lower and central Cook Inlet directly attributable to a saltwater halibut and salmon fishing trip in 1997 was $34 million (MMS 2003).

The sportfishing charters and shore-based fishers frequent Anchor River, Whiskey Gulch, Deep Creek, and Ninilchik River; other areas in Cook Inlet and Gulf Coast west of Gore Point; other areas in Cook Inlet north of the Ninilchik River; Barren Islands, Seldovia; Homer Spit; and various points along the shoreline (MMS 2003).

In addition to the waters of Cook Inlet, Kachemak Bay and the rivers and streams flowing into Cook Inlet account for a large proportion of the total sportfishing business in the entire state. The following are the most popular fresh water sportfishing activities on the rivers and streams of the Kenai Peninsula:

- Kenai River king salmon in June
- Russian River sockeye salmon in June
- Kasilof River king salmon in June
- Lower Kenai Peninsula salmon (Deep Creek, Ninilchik Creek, Anchor River, Homer Spit, and Halibut Lagoon) in June
- Second-run Kenai River fishery in July

- Silver salmon fisheries on all rivers and streams on the Kenai Peninsula beginning in the latter part of July and running through September and later (MMS 2003)

People gather razor clams and other clams (for example, *Myra* spp. and *Macoma balthica*) at various locations along the western side of the Kenai Peninsula and other shoreline areas bordering Cook Inlet. People collect steamer clams, mussels, and various other shellfish in Kachemak Bay. The saltwater sport fishery in Cook Inlet, the fresh water sport fishery on the Kenai Peninsula, and clamming on the shores of Cook Inlet are an important part of the overall economy (MMS 2003).

3.10.2 Waterfowl Hunting

Cook Inlet accounts for well over 30 percent of the state hunter days for waterfowl. The inlet is valued for its abundance of waterfowl as well as its proximity to Anchorage. Much of this harvest occurs during the fall and in the Susitna Flats and the Palmer Hay Flats, north of the general project location. Together these areas account for over 20 percent of the state's total harvest of geese and ducks. Other areas of Cook Inlet also provide ample supply of hunter days and game. Other important harvest locations within the upper and central inlet include Portage, Chickaloon Flats, Trading Bay, and Redoubt Bay (SAIC 2002).

3.11 CULTURAL, HISTORICAL, AND ARCHAEOLOGICAL RESOURCES

During the past few years, a number of new historic and prehistoric resources have been discovered onshore near the project area. Ethnological data collected in the 1930s, excavations at Yukon Island and Cottonwood Creek in the 1920s, and the discovery of a possible Tanaina village in the 1880s in Kachemak Bay are indications of the other resources that may lie undiscovered on the land around the project area. Artifacts found at prehistoric sites provide information about the settlements, cultural integration, and migration throughout the area. There are also offshore sites of archaeological importance, such as shipwrecks, in the project area. There are 79 known shipwrecks in Cook Inlet, 6 of which are within the lease-sale area. A total of 29 lease blocks have been identified as potentially having historic resources (MMS 2003).

Many of the TEK interviewees indicated that due to the social and cultural importance of subsistence harvesting to tribal members, the health of subsistence resources be considered by agencies and industry when making decisions such as the new platform discharge stipulations (SRB&A 2005). Some interviewees explained that they place importance on the ability to gather clean subsistence foods from the land and sea because such practices allow them to maintain a healthy culture and life (SRB&A 2005).

3.11.1 Onshore Archaeological Resources

3.11.1.1 Prehistoric Resources

There are numerous known prehistoric sites around the project area (MMS 2003). Some new sites were discovered in 1989 during the *Exxon Valdez* oil spill cleanup. Some of the oldest prehistoric resources of the east coast of the Alaska Peninsula date from 4,500 to 6,000 Before Present (BP) (the Takli Alder Phase). The resources around the project area indicate that the period from 500 to 1,800 BP was a time of increasing flow of people and their culture from Norton Sound of

Alaska to Kachemak Bay. Projectiles have been found dating to the years 1,500 to 1,800 BP (Cottonwood Phase). Fewer than 800 stone and bone artifacts have been found from the Takli Alder Phase (MMS 2003).

People have lived on the Kodiak Archipelago for about 7,000 years, as determined from the many archaeological resources recorded. Apparently, the archipelago was heavily populated along its coast and rivers and streams, where there was an abundant source of fish and wildlife (MMS 2003). Resources from the Koniag Phase (209 to 900 years BP) include barbed harpoons, armor rods, slats, and even shield parts, showing that the inhabitants needed to defend themselves from others during this period, as well as during the historic period (MMS 2003). Artifacts dating from 900 to 7,000 BP (Kachemak, Ocean Bay II, and Ocean Bay I Phases) have also been found (MMS 2003).

Kachemak Bay/Cook Inlet prehistoric resources include artifacts dating from 2,000 to 3,300+ BC. These artifacts include semisubterranean houses constructed of stone, wood, and whalebone, suggestive of Norton culture influence (MMS 2003).

3.11.1.2 Historic Resources

Brief contacts took place between Captain Cook (1778) and the Cook Inlet Natives. The first known awareness that other cultures existed in the land surrounding the lease-sale area occurred when Vitus Bering “discovered” Alaska in 1741 at Kayak Island. The first sustained influence on the peoples of Cook Inlet, however, occurred when the Shelikov-Golikov Company established a post at Three Saints Bay on Kodiak Island in 1784. Historic resources left from that era are abundant. In addition, Native villages, canneries, a fish hatchery, iceworks, saltworks, fishing cabins, fox farms, cattle ranches, cemeteries, churches, and military installations are just a few examples of the historic resources that have been found or might be present on Kodiak Island, the Kenai Peninsula, and Cook Inlet. Archaeological records of the Russian Period for the Pacific coast of the Alaska Peninsula are scarce, although a number of 18th century village sites have been identified from historic writings and maps (MMS 2003).

Villages on and across from Kodiak Island have yielded many resources. Kukak was one of the villages visited and described in 1813. In 1912, the eruption of Mt. Katmai (Novarupta) formed the Katmai National Park and motivated the permanent abandonment of the early villages of Katmai, Kaguyak, Ashivik, Swikshak, Kukak, Sutkum, and other villages on the eastern side of the Alaska Peninsula. Relocation to the Chignik area seemed to be the choice of those early residents.

Katmai is the most important of the known early historic sites on the eastern coast of the upper Alaska Peninsula. It was a large, year-round Koniag village before the arrival of the Russians and continued to be the largest village during the times of Russian occupation. As a fortified trading post of the Russian American Company, Katmai was the community on the eastern coast where Russians lived permanently. The old village was nearly completely buried by ash after the 1912 eruption, and high-rising, underground water levels have since made research on Katmai very difficult.

The village of Kanatak was occupied for a short time in the 1930s by Natives of the area who worked in nearby oil exploration activities. They left about 20 years later. Other oil exploration sites could be present elsewhere on the eastern coast. Cook Inlet coastal settlement in the upper Alaska Peninsula region has been slow, consisting mostly of small hunting and fishing cabins and canneries (MMS 2003).

3.11.1.3 Offshore Archaeological Resources

The MMS prepared an archaeological analysis for the offshore multiple sales for Cook Inlet (MMS 2003). Separate analyses were completed for prehistoric resources (Prehistoric Resource Analysis) and historic resources (Shipwreck Update Analysis). The analyses were based on a review of all available information and were intended to identify lease blocks within the lease-sale area that might contain archaeological resources. These blocks, if leased, will require an archaeological report to be prepared prior to the MMS' approval of any lease activities (MMS 2003).

Shipwreck Update Analysis. The MMS conducted a Shipwreck Update Analysis to provide an assessment of the potential for locating historic shipwrecks within the lease-sale area. This analysis was based primarily on the shipwreck baseline study, *Shipwrecks of the Alaskan Shelf and Shore*, completed in-house by the MMS Alaska Regional Office (Tornfelt and Burwell 1992, as cited in MMS 2003). The shipwreck database that was compiled for this study is continually updated by the MMS Alaska Regional Office as new data become available (MMS 2003).

Of the 79 shipwrecks in Cook Inlet, 6 are in the lease-sale area. There is not enough information on any of those six ships for them to be assigned to lease blocks. The other ships listed do not require archaeological review; however, they are listed because if found, each could be a hazard for drilling or become a source of small oil spills. The remaining ships are within the 3-mile limit or are outside the lease-sale area. These "coastal" ships represent 92 percent of all the wrecks, and the offshore ships represent 8 percent. The significance of these shipwrecks has not yet been fully assessed, and it is beyond the scope of this document to do so. However, for the purpose of this analysis, they will all be presumed to be historically significant. According to the Historic Resource Analysis of the Cook Inlet lease-sale area (MMS 2003), a total of 29 whole or partial lease blocks were identified as having potential historic resources. These blocks will require an archaeological report (MMS 2003).

3.12 ENVIRONMENTAL JUSTICE

Environmental Justice is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation and enforcement of environmental laws, regulation and policies. Executive Order (EO) 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, and the accompanying Presidential memorandum, directs each Federal Agency to consider Environmental Justice (EJ) as part of its mission and to develop environmental justice strategies with the goal of achieving environmental protection for all communities.

Fair treatment means that no group of people, including racial, ethnic or socioeconomic groups should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal and commercial operations or the execution of federal, state, local, and tribal programs and policies. Meaningful involvement means that (1) potentially affected community residents have an appropriate opportunity to participate in decisions about a proposed activity that will affect their environment and/or health; (2) the public's contribution can influence regulatory agency's decisions; (3) the concerns of all participants involved will be considered in the decision-making process; and (4) the decision-makers seek out and facilitate the involvement of those potentially affected.

The accompanying Presidential memorandum to EO 12898 highlights important ways for federal agencies to consider EJ under NEPA. These methods include identifying the affected area to determine if minority or low-income communities will be affected, analyzing the effects of the agency's actions on minority and low-income communities, evaluating public health data and assessing possible cultural, social or historical factors that may be affected by the action. Integration of environmental justice into agency decision-making through existing statutory programs is important. Integration can be achieved through equal enforcement of environmental laws, ensuring greater public participation and improving research and data collection for agency programs.

3.13 TRADITIONAL ECOLOGICAL KNOWLEDGE

Traditional ecological knowledge (TEK), or indigenous knowledge, uses the information, advice, and wisdom that have evolved over centuries of living as part of the environment. It is a valuable source of environmental information that allows communities to realize their own expertise and apply their own knowledge and practices to help protect their way of life. For the Southcentral Alaska region, a great deal of traditional knowledge has been collected from Native Alaskans through past and more recent testimony from community meetings on MMS lease-sale hearings, research sponsored by the MMS Environmental Studies Program, and subsistence-harvest surveys and ethnography conducted by other federal and state agencies. This information is disseminated in research reports, searchable online databases, and published scientific literature. Using this existing information incorporates traditional knowledge into the EA text and provides it to EPA decision makers without burdening Native Alaskans by requesting they provide information that has already been collected and disseminated. To fill possible data gaps in the TEK record, EPA also sponsored community meetings with Native Alaskans in the Cook Inlet area to collect site-specific TEK information that has been incorporated herein.

Certain issues raised by various tribal members through the TEK interview process were considered for mitigation, including:

- Discharge from platforms are a source of considerable concern to tribal leaders, according to the information they have received about the platforms, platform discharge, drilling muds and mixing zones, which were described as being too large, accommodating industry at the expense of the health of Cook Inlet. These individuals were more aware of the permit stipulations and requested that discharges not be permitted at all. Those that expressed this view were not in opposition to oil and gas activities, they simply believed the platform discharge should not jeopardize Cook Inlet waters and subsistence resources. Others requested that the platforms emit zero discharge until it can be ascertained that platform discharge does not adversely affect Cook Inlet waters and resources on the grounds that detrimental effects of such discharges cannot otherwise be ruled out and that no other area in the United States allows such discharges because agencies consider it to be harmful to waterways, so it should not be allowed in Cook Inlet (SRB&A 2005).

Mitigation for these issues have been and will be provided in the form of a full and open discussion and explanation of the mixing zones for each platform and a presentation to explain the basis of EPA's decision to allow discharges.

- TEK interviewees recognize waterways and the life they support as an integrated system, and so operations in upper Cook Inlet are a concern to them, just as are contaminants in other parts of the ocean. They also linked their concern about chronic contamination from platform discharges to the platforms because they are aware of contaminants in Cook Inlet and in subsistence foods, but do not have enough information to determine the source of this contamination, and thus, platform discharge remains a possible source. For example, they do not know the nature of platform discharges and cannot see it, so they do not clearly understand the effects of discharge and contaminants on animals and people, the levels of exposure to contaminants tribal members have had and continue to have, and whether today's subsistence consumption levels pose a threat to people's health.

  Because of this uncertainty, TEK interviewees asked that more be done to answer these questions by identifying sources of contaminants and identifying circulation and concentration patterns of platform discharge in Cook Inlet waters. Permit stipulations could include further studies to determine and demonstrate that Cook Inlet oil platform operations are in fact causing no harm and TEK interviewees asked that the EPA clearly communicate this information to the tribes and residents of Cook Inlet, and that oil operations adapt as necessary to eliminate any impacts.

  Another TEK interviewee who was familiar with platform activities expressed a specific concern regarding the concentration of minerals such as uranium, nickel and molybdenum associated with drilling muds and cuttings that are discharged during the production phase of oil drilling. This person believed that unregulated aspects of production phase drilling should at least be accounted for in the permit process, if not banned, due to their harmful effects to subsistence resources and habitat in Cook Inlet (SRB&A 2005).

  Mitigation to address these issues could be provided through making additional information available to the tribes at various stages during the development and production processes at the platforms to respond to these requests for additional information.

- TEK interviewees asked several questions about the discharge permit. They said that companies were recently fined for discharging drilling muds and wanted to know the effects of these violations on the fish in Cook Inlet. Other questions interviewees asked included:

  Where does the drilling mud go [upon disposal]?

What is the impact of platforms to our wildlife?

What is the [financial] cost of discharge permit?

What length of time does the permit cover?

Does the age of the platform influence the eligibility for a permit?

Does EPA have provisions in place that allow platform employees to anonymously report observations of harmful activity without fear of losing their jobs (whistle-blower protection)?

Is there a connection between the decline in beluga and the oil platforms?

How long have the platforms been there? And what is the most recent one?

We have a decline in beluga now; is there any way the decline in beluga could be associated with the rigs?

What are the floating rigs that "go out there and drill and then go somewhere else?

What is involved with drilling (i.e., how often, what are the effects, where)?

Does industry continue to do seismic blasts? How do these blasts affect fish and beluga?

Are the platforms and undersea pipelines too old to be operating safely and cleanly?

Do they use cement out there, too?

Are there measures in place on the platforms to ensure the mixing of drilling fluids is contained, so that the fluid is not released into the air and water?

Mitigation to address these issues is either provided elsewhere in the permit and fact sheet or could be provided through the response to comments process [for the draft permit and fact sheet] to address their concerns about platform discharge and the health of Cook Inlet waters.

TEK interviewees outlined the following specific possible additional mitigation measures:

- Continuous monitoring by establishing a round-the-clock observer system, perhaps monitoring at the platforms by tribal members
- Limit the number of platforms and/or cumulative allowable discharge pollution amount
- Honest, timely (annual) reporting and public information about platform activities and the effects of platform discharge

- Conduct more testing to prove discharge is harmless
- Have industry outline their plans to safely 'mothball' and eventually abandon the platforms and restore the area they have impacted once industry operations cease
- Spill damage prevention
- Protect salmon
- Establish and maintain open communication with oil industry representatives